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A

MANUAL

OF

COMPARATIVE ANATOMY

OF THE

DOMESTICATED QUADRUPEDS

BY

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TO

HIS EXCELLENCY THE RIGHT HONOURABLE
LORD REAY, L.L.D., K.G.C.I.E., &c.
GOVERNOR OF BOMBAY.

IN GRATEFUL ACKNOWLEDGMENT OF THE WARM INTEREST EVINCED BY HIS EXCELLENCY IN THE CAUSE OF VETERINARY SCIENCE AND THE UNTIRING ZEAL IN PROMOTING THE SPREAD OF TECHNICAL EDUCATION AMONG THE NATIVES OF THIS PRESIDENCY AS WELL AS IN ADMIRATION FOR HIS EXCELLENCY'S LITERARY MERITS.

THIS WORK IS WITH HIS EXCELLENCY'S KIND PERMISSION MOST RESPECTFULLY DEDICATED BY

THE AUTHOR.

PREFACE.

In his position as a lecturer on Anatomy in the Bombay Veterinary College, the Author found that various works on that science, though excellent in their own way, did not quite meet the requirements of the First Year Students for whom this manual is chiefly intended.

Professor *J. H. Steel's* excellent '*Outlines of Equine Anatomy*' and *Professor M 'Fadyean's* '*Anatomy of the horse*', though admirable guides for dissecting purposes, are too practical and too comprehensive to be easily grasped by beginners. Fleming's edition of Chauveau's Comparative Anatomy of the Domesticated Animals is more a book of reference for practitioners and higher students than a text book for beginners. Strangeways' Veterinary Anatomy is a very convenient and useful descriptive anatomy but the author believes that even this book is a little too elaborate for the junior class.

Hence the author has found it expedient to prepare this compendium for the use of his junior students. In this work attempt has been made to give in a tabular form the names of all muscles attached to different parts of the endoskeleton. Various important structures passing through all the foramina of the skull-bones have been fully named, and names of muscles surrounding and acting upon all the true (movable) joints of the body have been given and their actions have been described with the joints. Various points have been given to enable beginners to make out the sides to which different bones of the skeleton belong and to distinguish bones, similar in size and shape, from one another. In myology origin, insertion, action, nervous supply and relations important in a surgical point of view have been mentioned together with each muscle in order to enable students to remember them more easily.

But the chief merit of the work lies in the various Comparative and other tables which, the author believes, will be useful to students as well as to practitioners.

The Author claims no originality of the contents of his manual but it would be no exaggeration to state that the arrangement of tables is quite original. A good deal of attention and care has been paid to render this little volume as complete and as concise as possible in Osteology, Arthrology and Myology.

In connexion with this the author feels it an honor to mention the names of two worthy gentlemen whose assistance stimulated him in his present effort. He is deeply indebted to Dr. W. J. MOORE, C.I.E., Surgeon-General with theGovernment of Bombay, who has been taking a keen interest in the welfare of the class of Assistant Surgeons to which the author has the honor to belong, for giving him this opportunity by appointing him to the post, and, for various hints on the subject, to Professor J. H. STEEL who has made himself known by his several works on Veterinary Science.

The works referred to in the compilation of this manual are Fleming's edition of 'Chauveau's Comparative Anatomy of the Domesticated Animals', Strangeways' Veterinary Anatomy, Steel's 'Outlines of Equine Anatomy', M 'Fadyeans 'The Anatomy of the Horse', Gray's Human Anatomy and Kirkes' Handbook of Physiology.

Lastly the author's thanks are due to a veterinary student, Mr. S. K. Doctor for assisting him in getting this work through the press.

N. H. E. S

Sukhia House, Fort,
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INTRODUCTION.

Anatomy is the science of the structure of the body learned by dissection. Zootomy or Animal Anatomy is the study of the tissues of the animal body with regard to their forms, situations, structures and relations, and includes several varieties viz., Anthropotomy or Human Anatomy, Hippotomy or Equine Anatomy, Comparative Anatomy &c. Comparative Anatomy or Zoology is the study of the organisation of the entire animal kingdom, and by it various deviations and similarities in the same organ or the same series of organs in each class, family, genus or species have been noted down by referring them to certain types or standards. Veterinary Anatomy is that part of the Comparative Anatomy which deals with the study of the domesticated animals, and in it the Horse is taken as its type.

The domesticated animals treated of in Veterinary Anatomy include domesticated Mammals and Birds.

The mammals are characterized by the females being supplied with breasts or paps with which they suckle their young, and birds, by their producing young from eggs by hatching them usually outside the body, by never suckling their young, and having a covering of feathers.

The domesticated mammals include several orders viz., the Solidungula or Solipeds, Ruminantia, Pachydermata, Carnivora, and Rodentia. The domesticated birds belong to two orders viz., the Rasores or Gallinaceous, and Natatores or Palmipeds.

The Solipeds have only one digit on each extremity and comparatively small, single, and simple stomach. To them belong the

Horse, Ass, Mule (the produce of the male ass with the mare), and Hinny (the produce of the horse with the female ass).

The Ruminantia includes the ox, sheep, and goat. They have cloven-feet i.e., two perfect digits on each limb, no front teeth in the upper jaw, and very large and complex stomachs. They are generally provided with a pair of hollow horns supported on bony cores.

The Pachydermata, to which the common pig belongs, is characterised by very prominent canine teeth or tusks, a prominent nose or snout, a somewhat complex stomach, and four digits (two long and two short) on each limb.

The Carnivora have large canine teeth, a small stomach, comparatively short intestines, and five digits on each fore-limb, and 4 or 5 on each hind limb, terminating in sharp or blunt, retractile or nonretractile claws. The dog and cat belong to this order.

The Rodentia, in which the rabbit is classed, have two large chisel-shaped incisors in each jaw and no canine teeth.

The Rasores include the common fowl, guinea fowl, turkey, and igeons, and the Natatores comprise the geese and ducks which ave web-feet.

General Outline of the animal organism.

The animal bodies contain *fluids* and *solids*. The most important of the *fluids* are the blood, lymph, and chyle. The *solids* consist of three principal anatomical elements viz.,—the granule, cell, and fibre, which on union form what are called the *Tissues*. When the tissues are formed of one kind of element they are said to be '*Simple Tissues*', e. g., the Epithelium, and when by union of several elements, *Compound or Composite Tissues*, e. g., the nervous tissue. As the anatomical elements by union form

the tissues, the tissues on union form what are called *Organs*, which are groups of tissues arranged in definite forms and perform distinct functions. All animal organs are enclosed between two membranes, called limitary (mucous membrane) and tegumentary (the skin) membranes, which are continuous with each other at the margin of the natural orifices. A group of organs performing the same function is called an *Apparatus*. The animal organism consists of several different Apparatus, viz., (1) Locomotory, (2) Digestive, (3) Respiratory, (4) Urinary, (5) Circulatory, (6) Innervatory (Nervous), (7) Sensory, and (8) Generative apparatus.

The *Locomotory* apparatus includes those organs by which different movements of an animal are effected and which are of 2 kinds viz., the Bones with articulations and Muscles. Various anatomical terms are applied to the study of different organs. Thus **Osteology** is that branch of descriptive anatomy which deals with the bones; **Arthrology** treats of the articulations or modes of union between the bones, and **Myology**, of the muscular system. These three branches have been dealt with in this volume. **Splanchnology** means the study of the viscera, **Angiology** of the circulatory and absorbent systems, **Neurology** of the nervous system, **Æsthesiology** of the organs of sense, and **Embryology** of the fœtal animal frame. The terms *analogy* and *homology* are often used in the study of comparative anatomy. Organs are said to be *analogous* when they perform the same function and may or may not differ in structure; but when they differ in function and resemble in structure or form they are said to be *homologous*. Thus the lungs of a mammal are analogous to the gills of a fish as they both perform the same function of purifying the blood, and the human finger is the homologue of the digit of a horse as they both have the same general structure.

Osteology.

Structure of Bone.

Bone is a hard, tough, elastic structure which forms the endoskeleton of the animal body. The bones are of different sizes, forms, and densities. In the limbs they are cylindrical to support the weight of the body, and act as levers for the action of the muscles and joints to effect locomotion of the body. Where they form cavities for the reception and protection of important organs, as the brain, heart, lungs, and pelvic viscera, they assume a flat expanded form.

Bone is the harder structure than any other animal tissues except the teeth, and has a higher specific gravity, from 1.87 to 1.97. Living bone is pinkish white externally and deep red within, insensitive, and elastic.

Chemical Composition :—Bone consists of a basis of animal matter in which are intimately deposited inorganic salts. The former gives elasticity and toughness to the bone, the latter, the hardness and density. The organic and inorganic constituents can be separated by calcining bone or steeping it in dilute mineral acid as hydrochloric. By the first method the animal matter burns away and inorganic salts are left behind in the form of a white, friable mass retaining the shape of the bone; by the second method, the acid dissolves away the inorganic salts and the animal matter is left behind in the shape of the bone but extremely flexible.

Percentage Composition :—

Animal matter (Gelatine, fat and blood vessels)		33.30
Inorganic or Earthy matter :—		
Phosphate of lime	51.04	
Carbonate of lime	11.30	
Fluoride of Calcium	2.00	66.7
Phosphate of Magnesia	1.16	
Soda and Chloride of sodium	1.20	
		100.

The relative proportions of the two constituents or bone vary in different bones of the skeleton and at different periods of life Thus, the bones of the head including the petrosal, which is the hardest one in the body, and the long bones of the limbs contain more earthy matter than those of the trunk as the ribs &c. The bones in the young contain more animal matter (nearly one-half of the bone) than those in the adult, and those in the adult, more than in the old; hence the bones of very old animals are brittle and more liable to fracture.

In adult bones the proportion of animal matter is about a third but it varies in different animals and in different bones of the same animal. Some of the diseases of bones are mainly due to the disproportion between the two constituents of bone. Thus, in the disease called 'Rickets', which is common in young ones in whom the animal matter predominates, the bones become bent and curved either from the superincumbent weight, or under the action of certain muscles. The proportion of earthy matter, upon which depends the degree of hardness of bone, also, differs with the age, different parts of the skeleton, the breed, and the class of animals. Thus birds and the animals of the class to which the chamois belongs have very hard and brittle bones, whereas fish bones are soft and flexible; also a thorough-bred horse, in whom a greater density of bone is necessary to withstand the intense concussion of speedy action, has more compact leg-bones than those of a heavy cart-horse in whom the bones are thinner in compact tissue and lighter but more expanded to supply greater surface for muscular attachments.

In marine creatures the bones are usually solid, but in the active land quadrupeds and the human beings the long bones are hollow in their shafts by which, after the well known principle of the hollow column, the *strength and lightness* of the limb bones are increased.

Covering of bone :—The Periosteum.—

All bones are surrounded externally by a tough, highly vascular fibrous membrane—called the *periosteum*, which is very firmly adherent to the bone and covers the entire bone with the exception of the articular surfaces. It affords support and protection to the bone and attachment to tendons and ligaments, and serves as a nidus for the ramification of vessels previous to their distribution in the bone; hence the liability of bone to exfoliation or necrosis (death) when from injury or otherwise it is laid bare of this membrane. It is composed of two layers :—(*a*) the outer, fibrous, formed chiefly of connecting fibrous tissue which supports the vessels entering the bone, & (*b*) the inner, cellular, also called the Osteogenetic (bone-forming) layer, consisting of elastic fibres, capillaries, and osteoblasts or bone producing cells.

The periosteum of the cranial bones is called the *pericranium*.

Minute structure of bone :—There are 2 kinds of osseous tissue—one of which is hard, compact and ivory-like, and situated externally; the other is porous and sponge-like and lying internally. The former is called the *compact tissue*, and the latter, the *cancellous*. In flat bones the compact tissue forms two plates with the cancellous tissue between them. Although the compact osseous tissue appears dense with the naked eye, under the microscope it is seen to be porous resembling the cancellous, and presents when cut transversely many important structures viz, *Haversian canals*, *lacunæ*, *canaliculi*, *osteoblasts*, and *lamellæ* with perforating fibres, all contained in a granular or amorphous fundamental substance.

(a) Haversian canals:—will be seen as central dark spots or round apertures of 1/200 to 1/1000 of an inch in diameter. They during life lodge blood-vessels, nerves, and lymphatics and by means

of them blood is conveyed to all, even the densest, parts of the bone. The smaller Haversian canals contain arteries, and the larger, veins; a single vessel being lodged in each canal. They run parallel to each other and to the long axis of the bone, and communicate externally with the periosteum and internally with the medullary cavity and with other Haversian canals by means of transverse branches of communication. These canals are surrounded by numerous concentric rings or layers of bone called Haversian lamellæ of bone.

(b). Lacunæ :—are seen as elongated dark spots within the Haversian lamellæ arranged in a circle. They are in reality minute irregularly fusiform cavities having their long diameter, about 1/1800 of an inch parallel to the Haversian lamellæ and their short diameter about 1/3600 of an inch. These cavities communicate with one another and with the neighbouring Haversian canals by means of numerous fine tubules of 1/7000 th of an inch in diameter, (c) the Canaliculi; which originate from the irregular borders of the lacunæ and appear under the microscope as dark radiating lines. The lacunæ are occupied by branched nucleated cells, (d) the Bone cells or Osteoblasts, which send branches along the canaliculi. These lacunæ and canaliculi only transmit the fluid portion of the blood, and absorb nutrient matter from the Haversian blood-vessels and convey it to the very substance of the bone which they traverse. Virchow believes that by means of the osteoblasts the fluids necessary for nutrition are brought into contact with the ultimate tissue of the bone. These four elements viz., Haversian canals, lacunæ, canaliculi, and osteoblasts, are seen only in the compact tissue of the shaft of long bones, while in the compact tissue of other bones, where it is a thin layer, only the lacunæ, canaliculi, and osteoblasts are found.

(e) Lamellæ :—There are three distinct sets of lamellæ as follows :—(1) The *concentric rings* or layers of bone varying from 2 to 8 in number and having between them lacunæ and canaliculi arranged concentrically round each Haversian canal are called the Special, Secondary, or Haversian lamellæ.

(2) *Primary, General, Fundamental, Peripheral* or *Circumferential lamellæ* are several concentric bony layers arranged round the medullary cavity or the axis of the bone itself. They are most perceptible on the surface of the bone.

(3) *Interstitial* or *Connecting lamellæ* are found between the Haversian lamellæ connecting them.

The last two sets of lamellæ have no Haversian canals but are supplied with nutritive material by means of lacunæ and canaliculi.

(f) *Perforating fibres* :—are fibres of bone which cross the lamellæ in various directions and pin them together. They are well seen in a decalcified piece of bone by maceration in dilute mineral acid.

(g) The interspaces between the lacunæ and canaliculi are filled with granular homogeneous white solid material—the *ultimate mineral base of the bone,* which when acted upon by acid leaves a finely reticular frame-work of organic matter which is the ultimate structure of the lamellæ.

In a longitudinal section of the compact tissue the appearances slightly differ from those in the transverse, viz., the concentric rings or lamellæ are replaced by rows of lacunæ parallel to the course of the Haversian canals, and these canals appear like half-tubes or grooves, instead of circular spaces, and branching and communicating with one another.

Cancellated or Spongy tissue :—consists of a large number

of brittle osseous plates with spaces between them, called the *Cancelli* or *Medullary spaces*, which contain marrow and blood vessels and perform the same function as the Haversian canals in the more compact tissue. Its structure resembles that of the compact tissue in all its essential particulars except that in it there are no Haversian canals, their place being taken by the cancelli, and that the lacunæ and canaliculi are irregularly disposed and not in concentric rings. This kind of osseous tissue is chiefly present at the expanded ends of long bones and gives lightness as well as strength to the bone, and is called the *diploë* in the bones of the cranium.

Contents of bone:—include marrow and blood-vessels with lymphatics and nerves.

The **Medulla** or **Marrow** is a pulpy fatty substance of two distinct varieties, the red and yellow, the cells of which are supported by areolar tissue.

1:—*Red marrow* is that which is found in the cancelli, the spaces of the cancellous tissue, of the bone and is highly vascular from containing many blood vessels, thus maintaining the nutrition of the spongy bone. It consists of a few fat cells, a few large cells with many nuclei (GIANT or Myeloid cells), a large number of marrow cells (small cells with a spherical nucleus), and a small amount of delicate areolar tissue as the basis.

2:—*Yellow marrow* is that variety which fills the medullary canal of long bones and consists chiefly of fat cells with blood-vessels, and a few marrow cells with a little areolar tissue as the basis.

A delicate vascular membrane which lines the medullary canal is called the *Endosteum* or *medullary membrane* and consists of fine areolar tissue. It sends off branches which support the marrow and ramifications of the nutrient arteries.

In some class of animals the medullary cavity instead of containing marrow cells contain air-cells of rarified air, as in birds. In animals of the mammalian class the air-cells of bone are found in the head bones, and are filled with air from the nasal or ear chambers and not from the lungs as in birds. Such cells are called sinuses as the frontal, ethmoidal, &c. The frontal sinuses extend backwards over the top of the skull in the ruminants and some other quadrupeds, and penetrate the cores of the horns in oxen, sheep, and certain antilopes.

Blood vessels of bones :—

There are three sets of arteries:—(1) The first set consists of those which penetrate the interior of the medullary canal of the long bones by a particular orifice, the *nutrient foramen*. This set is seldom to be found in the flat and short bones.

(2) The second set penetrates the spongy tissue of the extremities of the long bones by numerous nutrient foramina.

(3) The third set consists of branches of the periostic network which enter the superficial Haversian canals.

The veins of bones accompany the arteries and come out by special very large openings at those points of the bone where the spongy tissue is abundant.

Nerves of bones :—They accompany the nutrient arteries into the interior of the bone, and are both from the cerebro-spinal and sympathetic systems, the latter being always *vaso-motory*.

Lymphatic vessels of bones have been traced in the interior of bones, but some anatomists deny their existence.

Development of bone or ossification :—

There are 2 forms of ossification viz., ossification in Cartilage, Intracartilaginous ossification or Endochondral formation, and ossification in membrane, or Periosteal or Intramembranous formation. In all bones ossification begins at one or more points

termed 'Centres of ossification', and bones are formed by lime salts depositing either in cartilage or in membrane.

(a) *Endochondral Formation* :—The process by which the cartilage is transformed into the proper bony tissue includes six stages viz., :—

I :—Vascularisation of the cartilage.

II :—Calcification of Cartilaginous matrix.

III :— Substitution of embryonic spongy bone for cartilage.

IV :—Substitution of Periosteal bone for the primary embryonic spongy tissue.

V :—Absorption of the Inner Layers of the Periosteal bone.

VI :—Formation of compact bone.

(b) *Ossification in membrane* :—in which the bone is formed from the inner, cellular, or osteogenetic layer of the periosteum which first becomes highly vascular. Then the finely fibrillar network of this layer becomes transformed into bone matrix and its periosteal cells into bone corpuscles (osteoblasts).

The limb bones, vertebræ, sternum, ribs, and bones of the base of the skull are formed from cartilage, the rest from the membrane.

Growth of bones :—Bones grow *in length* by intracartilaginous and *in thickness* by intramembranous ossification. It must be clearly understood that calicification is not ossification but is simply a deposition of lime salts in an animal tissue, and is a change of chemical composition rather than of structure, while ossification means the formation of true bone.

Functions of bones :—They form the framework of the body, and serve as protectors to internal organs in the trunk and skull, and as levers worked by muscles in the limbs.

Classes of bones.

Bones are divisible into 4 classes viz., :—

1.:—Long or Cylindrical bones consist of a lengthened hollow cylinder, the *Shaft or Diaphysis*, and two expanded ends—the

Extremities or *Epiphyses*, e. g., the humerus &c. The central hollow canal in the shaft is called the *Medullary Canal* around which is the cancellous tissue which is enclosed in a zone of compact tissue. The shaft is pierced by a foramen, called the *Medullary* or *Nutrient Foramen*. The long bones are found in the limbs, where they act as levers and columns of support.

2:—**Flat, Wide or Tabular bones,** which present two broad surfaces e. g., the Scapula &c., consist of two thin plates of compact tissue (an outer more elastic, thicker and tougher, and an inner harder but less elastic, thinner, and more liable to fracture) and a central one of cancellous tissue. In the cranial bones the plates of compact tissue are called the *tables*, and the central cancellous tissue, the *diploë*. The flat bones form cavities for the reception and protection of important organs as the cranium, chest, and pelvis. The *vomer*, *nasal*, and *lachrymal* are also flat bones.

3:—**Short bones,** which have a variable number of surfaces, and plane angles and are nearly equal in all their dimensions e.g., the carpal, tarsal, and sesamoid bones including the patellæ, consist of cancellous tissue throughout with a thin crust of compact tissue outside. They are found in those parts of the skeleton where there is slight and limi motion and where strength and compactness are required.

4:—**Irregular or Mixed bones** are those which have many angles and indentations, and which from their peculiar form e. g., the vertebræ &c. cannot be grouped under any of the three preceding classes. They consist of a thin external layer of compact tissue enclosing the cancellous tissue within, and are the vertebræ including the sacrum and coccygeal bones, wormian, temporal, sphenoid, ethmoid, malar, superior-, anterior-, and inferior maxillarys, palate, pterygoid, turbinated, hyoid, small pastern, and coffin.

Surfaces of bones :—

Bones present *eminences* and *depressions*, either of which may be *Articular* or *Non-Articular*. Articular eminences and depressions are those which go into the formation of joints.

Tabular view of the eminences and depressions.

Eminences.

Articular.

- *Heads.*—Round and separated from the rest of the bone by a constricted *cervix* or *neck*.
- *Condyles.*—Ovoid convexities.

Non-articular.

- *Tubercles.*—Small, rough, and irregular. A collection of which forms an *Imprint*.
- *Tuberosities* or *Protuberances.*—Large, wide-based, round, and but slightly prominent.
- *Trochanters.*—Large, wide-based, round, and prominent.
- *Processes* or *Apophyses.*—Large, prominent, and much detached from the bone.
- *Spines.*—Slender and sharp-pointed.
- *Ridges*, *Lines* or *Crests.*—Narrow and roughened, with elongated bases of attachment.

Depressions.

Articular.

- *Glenoid.*—Shallow and saucer-like.
- *Cotyloid.*—Deep and cup like.

Non-articular.

- *Channels* or *Furrows.*—Wide, deep, and smooth.
- *Grooves.*—Narrow, long, and smooth-bottomed.
- *Fissures.*—Narrow and rough.
- *Fossæ.*—Smooth and shallow.
- *Notches.*—Cavities excavated on the margins of bones.
- *Sinuses* or *Cells.*—Cavities of open spaces in the interiors of bones separated by imperfect bony partitions.
- *Digital impressions.*—Depressions, which appear as if made by the pressure of the finger.
- *Foramina.*—Openings passing quite through bones.
- *Canals*, *Aqueducts*, or *Conduits.*—Foramina of a certain length.
- *Fissures.*—Narrow long foramina.
- *Hiatus.*—Wide orifice with irregular outlines and leading to two or more foramina or cavities.
- *Meatus.*—Wide canal which may be closed at one end.

An *Apophysis* which is a non-articular eminence prominently projecting from the surface of a bone and has never been separate from, or moveable upon the bone, must be distinguished from an *epiphysis*, which is one of the extremities of a long bone developed as a separate piece from the rest of the bone with which it afterwards joins. The term *facet* is applied to indistinct articular depressions or eminences.

The Skeleton.

The internal or bony skeleton, which forms the basis of the animal body, is called the *Endo-skeleton*, and the external covering which gives the particular appearance to the animal is termed the *Exoskeleton* or *Dermoskeleton*. The term *skeleton* means the framework of the animal body including the bones, cartilages, and ligaments. *A Natural skeleton* is that in which the bones, cartilages, and ligaments are dried and preserved, while in an *Artificial skeleton* the natural ligaments are removed and replaced by wires or screws.

The *Axial skeleton* or the *Trunk* is the main part of a skeleton, in or about which are situated the different organs of the animal body. The *Appendicular skeleton* or the *limbs* mean the appendages which support the axial skeleton. The *proximal* end of a part or parts of a skeleton is that which is nearest to the vertebral column, and the *distal* end is that which is remote or further away from the vertebral column.

The Trunk is made up of 3 parts viz., the *Head* (the anterior pyramidal expansion of the spine), the *Spine* (the flexible and bent column composed of a series of bones called *vertebræ*), and the *Thorax* (the osseo-cartilaginous cage which encloses and protects the principal organs of respiration and circulation).

The Limbs are four in number, two anterior and two posterior, each of which is divisible into four principal regions. In the mammals all four limbs act as columns of support to the trunk, while in Birds the two posterior limbs alone do so, and the two anterior, called the *wings*, perform the function of flight.

TABLE SHOWING THE DIVISIONS OF A SKELTON.

- **Skeleton.**
  - Trunk or Axial Skeleton.
    - *Head or Skull.*
      - Cranium.
      - Face.
    - *Spine or Vertebral Column.*
      - Cervical
      - Dorsal
      - Lumbar
      - Sacral
      - Coccygeal
    - *Thorax or Chest.*
      - Ribs.
      - Sternum.
  - Limbs or Appendicular Skeleton.
    - *Anterior or Pectoral.*
      - Shoulder.
      - Arm.
      - Forearm.
      - Forefoot or Hand.
    - *Posterior or Pelvic.*
      - Haunch or Pelvis.
      - Thigh.
      - Leg.
      - Hindfoot.

The number of bones of the skeleton of the domesticated quadrupeds at the adult period of life varies according to the species, and the following is the table showing the respective numbers of bones found in different regions of the trunk and limbs of different domesticated quadrupeds.

Part or Region.		Solipeds.*	Ruminants.†	Carnivora. ¶	Pig.
‡ Head		28	28	28	29
§Vertebral column		44	43	43	42
Thorax		37	27	27	29
Shoulder	Double regions.	1-2	1-2	2-4(clavicle present.)	1-2
Arm		1-2	1-2	1-2	1-2
Fore-arm		2-4	2-4	2-4	2-4
Forefoot		16-32	20-40	36-72	36-72
Pelvis		1-2	1-2	1-2	1-2
Thigh		1-2	1-2	1-2	1-2
Leg		3-6	3-6	3-6	3-6
Hindfoot		15-30	19-38	32-64	36-72
Total.....		189	194	254	262

*:—In the ass and sometimes in the mule one lumbar vertebra less is found.

†:—The Ossa Cordis have not been counted.

¶:—The Os penis has not been included.

‡:—The Os Hyoides is reckoned as a single bone.

§:—The Sacrum is reckoned as a single bone, and the coccygeal vertebræ, 12 for the horse, 16 for the ox, 15 for the dog, and 14 for the pig.

Vertebral Column or Spine.

The *Vertebral or Spinal column* is a flexible column formed of a series of bones—*Vertebræ*—firmly united together by inter-vertebral discs of fibro-cartilage and ligaments, situated in the middle and upper part of the trunk, and extending the whole length of the body. It protects the spinal cord and sustains the thorax with its enclosed organs of circulation and respiration.

It is divided into 5 regions :—

1:—The	*Cervical*,	or region of the neck, having	7	vertebræ.
2:—The	*Dorsal*,	„ back, „	18	„
3:—The	*Lumbar*,	„ loins, „	6	„
4:—The	*Sacral*,	„ croup, „	5	„
5:—The	*Coccygeal*,	„ tail, „	13 to 18	„

Vertebræ of the first three regions are called *true* vertebræ as they retain certain *typical* parts of a vertebra throughout the life of the animal, and never, in health, ossify ; while those of the Sacral and Coccygeal regions are termed *false* vertebræ for they loose their *essential* parts as in the coccygeal vertebræ (save the first 3 or 4), or become united with one another by ossification as in the sacrum.

Common characters of a true vertebra.

A *true* vertebra presents several typical parts viz., :-

(a) A solid piece of bone, the *body* or *centrum* ; (*b*) an arch or ring, the *neural arch* or *spinal foramen*, the sides of which are formed by two lateral processes of bone—the *pedicles*, and the roof, by two small plates of bone, the *laminæ*. The neural arches with their connecting ligaments form the *neural* or *Spinal canal*, which extends from the head to the tail and contains the spinal cord with its membranes and blood-vessels ; (c) an excavation in the anterior and posterior surfaces of each pedicle, termed the *anterior* and *posterior notches*, which by juxtaposition form the *Intervertebral Foramina* for the passage of the spinal nerves and blood-vessels ; (d) a superior spinous process, the *Neural spine* ; (e) an inferior spinous process, the *hypapophysis*, ; (f) two processes of bone, one on each side, arising from the sides of the centrum and pedicle, the *Transverse processes* or *diapophyses* ; and (g) four processes of bone, two anterior and two posterior, extending from the supero-lateral parts of the neural arch, the *Oblique* or *Articular processes* or *Zygapophyses*.

Table of the general Characters of the Cervical, Dorsal, and Lumbar Vertebræ.

Designation.	Cervical.	Dorsal.	Lumbar.
Centrum.	Largest, longest and quadrangular, with well detached anterior globular heads and posterior cup-like extremities.	Smallest, shortest, and semicircular, with slightly convex anterior and shallow posterior extremities. *Four concave articular facets*, 2 anterior and 2 posterior, for the heads of ribs.	Prismatic and longer, with more convex anterior and more concave posterior extremities than in the dorsal.
Neural arch.	Largest, especially in its vertical diameter.	Smallest.	Larger than in the dorsal, and especially in its transverse diameter.
Anterior notches.	Present throughout, widest and deepest, but converted into foramina in the 1st and 2nd.	Present only in the first 4 or 5, and the 18th.	Present except in the first 1 or 2, and wider than in the dorsal.
Posterior notches.	Present except in the 1st, and widest and deepest.	Present throughout, but converted into foramina in from the 5th to 17th.	Present except in the first 1 or 2.
Superior spine.	Rudimentary and bifid posteriorly.	Very high and largest.	Shorter but wider & stronger than in the dorsal.
Inferior spine.	More or less prominent.	Rudimentary as a median ridge	Rudimentary but more marked than in the dorsal.

Table of the general Characters of the Cervical, Dorsal, and Lumbar Vertebræ.—(*continued.*)

Designation.	Cervical.	Dorsal.	Lumbar.
Transverse processes.	Bifid, broader, and shorter, and pierced at their base by the *Vertebral Foramina*, through which pass the vertebral artery and vein.	Single & shortest, and present postero-inferiorly a *flat facet* for the *tubercle* of ribs.	Single, longest & *broadest*, and directed *horizontally outwards.*
Articular processes.	Largest, most prominent, and having *flattened* and *vertically* oval articular facets.	Smallest, narrowest and having flattened *horizontal* facets. The anterior ones look outwards, and the posterior inwards.	Medium sized, and concave anterior and convex posterior articular facets, which respectively look inwards and outwards.

Table showing the Specific Characters of the different cervical, dorsal, and lumbar vertebræ

Designation.	Cervical.	Dorsal.	Lumbar.
Centrum.	Increases in vertical and transverse diameters, and diminishes in antero-posterior, from 1st to 7th.	Increases in vertical diameter from 1st to 18th, and the articular facets for the heads of ribs gradually decrease in depth from 1st to 18th.	Diminishes in vertical diameter, and increases in transverse from 1st to 6th.
Neural arch.	Increases in size from 2nd to 7th, very large in the 1st.	Largest in the anterior six, smallest in the central six, and larger in the posterior six.	Decreases in size from 1st to 6th, especially in its vertical diameter.
Anterior notches.	Increase in width and depth from 3rd to 7th, and converted into foramina in the 1st and 2nd.	Absent in from 5th to 17th, and decrease in depth from 1st to 4th ; the 18th very small.	Absent in the first 1 or 2.
Posterior notches.	Increase in width and depth from 2nd to 7th; absent in the first.	Increase in depth from 1st to 4th; converted into foramina from 5th to 17th; very small in the 18th.	Absent in the

Table showing the Specific Characters of the different cervical, dorsal, and lumbar vertebræ.—*(Continued.)*

Designation.	Cervical.	Dorsal.	Lumbar.
Superior spine.	Absent in the 1st; very long in the 2nd.; decreases in size from 3rd to 6th; very high in the 7th.	Increases in height from 1st to 5th (which is the highest) & decreases from 6th to 13th; directed backwards in the anterior twelve, nearly upright in the 13th, 14th & 15th, and forwards in the last three.	Decreases in width, and becomes more and more concave anteriorly from 1st to 6th.
Inferior spine.	Becomes less marked from 1st to 7th; absent in the 6th.	Only indistinctly marked in the anterior six and the last three.	Becomes shorter and wider from 1st to 6th.
Transverse processes.	Largest in the 1st, smallest in the 2nd, and increase in size from 3rd to 7th; Single in the 1st, 2nd and 7th, bifid in the 3rd, 4th and 5th, and trifid in the 6th. Vertebral foramina are usually absent in the 7th.	Diminish in size from 1st to 18th.	Longest in the 3rd and 4th thickest in the 5th or 6th; directed backwards in the 1st and 2nd, horizontally outwards in the 3rd, and forwards in the last three.
Articular processes.	Increase in size and become more and more oblique from 3rd to 7th.	Gradually approach the median line from 1st to 10th and become wider	Grow farther from the median line from 1st to 6th.

Special vertebræ.

The Atlas.

The *First cervical vertebra* or the *Atlas*, so called from its supporting the globe of the head, has :—(*a*) a very small *centrum* presenting anteriorly 2 notches for the superior and inferior suspensory ligaments, and 2 articular glenoid cavities for the Occipital condyles ; inferiorly a prominent tubercle the *Inferior spine;* and posteriorly 2 undulated facets for the Axis. (*b*) A very large *neural arch*— the *Ring* of the *Atlas*— which lodges the commencing portion of the spinal cord with its membranes, the basilar and other meningeal arteries and veins, the spinal accessory nerve, and fat, and posteriorly the odontoid process of the Axis with its ligaments. Its roof (*laminæ*) is pierced by 2 foramina for the suboccipital nerve and a branch of the basilar artery. Its floor is divided by a transverse ridge into an anterior rough portion, for the attachment of the odontoid ligaments, and a posterior smooth concave one for the odontoid process. Its sides (*pedicles*) have each a groove for the lodgement of a venous sinus which is continuous with a foramen, which opens on the inferior surface of the *wing* and transmits a vein from the sinus. (*c*) The *neural* spine is absent. (*d*) The Transverse processes are large, flat, single, and prominent, and are called the *Wings* or *Alæ* of the atlas. Each presents at its base three foramina; one posterior largest, for the passage of the anastomotic branch of the occipital artery, and the two anterior, one external and the other internal, respectively giving passage to the occipital vessels and nerve, and to the cerebro-spinal artery and the first spinal nerve.

The Dentata.

The *Second cervical vertebra* or the *Dentata* is also called the *Axis* as the head rotates upon it. The centrum ha:

anteriorly a conical process—the odontoid process—which projects into the ring of the atlas and presents at its base two undulated facets for articulation with those of the atlas. The *neural* arch is narrow, the *anterior notches* are converted into 2 foramina for the passage of the spinal nerves, the *neural spine* is very long, strong, and bifid posteriorly, the *Transverse processes* are single and smallest in the cervical region and pierced by very small vertebral foramina, and the *Inferior spine* arises from a notch on the under surface of the odontoid process and terminates posteriorly in a tubercle.

In the horse between the atlas and the axis a considerable space—*the atlo-axoid space*—is left superiorly where the operation of "pithing" is easily done.

The *Sixth cervical vertebra* has a rudimentary superior spine, large sized vertebral foramina, notches, and neural arch, no inferior spine, and *trifid* transverse processes which give it the name of *Tricuspid vertebra.*

The *Seventh Cervical vertebra* has a very prominent superior spine, hence it is called the *Vertebra Prominens.* It has a very rudimentary inferior spine, small and single transverse processes usually without vertebral foramina, largest notches and neural arch (those of the atlas excepted), and a concave demifacet posteriorly, on each side of its centrum, for the heads of the first pair of ribs.

The *First dorsal vertebra* much resembles the 7th cervical, but differs from it in having 4 facets, 2 *anterior* and 2 posterior, for the heads of ribs.

The *Last* or *Eighteenth dorsal vertebra* has no posterior facets for the ribs, and the anterior ones are blended with those of its transverse processes. Thus it has only 8 articular

surfaces unlike the other dorsal vertebræ which have in all 12 articular surfaces—3 anterior and 3 posterior (as in the cervical vertebræ), and 3 on each side (six on two sides) for the heads and tubercles of ribs.

The *Fifth lumbar vertebra* has an oval articular facet on the posterior border of each of its transverse processes, and the *sixth lumbar vertebra* has two oval facets, one on the anterior, and the other on the posterior border of each of its transverse processes.

Thus the four first lumbar vertebræ have six articular facets as usual, the fifth has 8, and the sixth has 10 in all.

The Sacrum.

Is the bone of the croup, triangular, and formed of 5 false vertebræ united by articulation in the young animal and by ossification in the adult. It has :—

The *Superior surface* :—convex and presenting centrally the Supersacral spine, a groove on each side with 4 superior sacral foramina (for the superior branches of the sacral nerves) and a ridge most externally.

The *Inferior or Pelvic Surface* :—concave and presenting anteriorly the Sacral Promontory (not prominent in the horse) and 2 notches for the 1st sacral nerves, laterally 4 inferior sacral foramina (for the inferior branches of the sacral nerves and branches of the lateral sacral arteries and veins), and 4 transverse ridges crossing the surface.

Two Borders (right and left):—anteriorly rough for the sacro-iliac joint, and posteriorly rough for the sacro-sciatic ligaments and end in the *Sacral cornua*.

The *Anterior extremity* or *base* :—presents a central oval convex articular surface for the last lumbar, above which is the triangular (spinal) canal and laterally are 2 broad convex facets on thick transverse processes for those of the last lumbar.

The *Posterior extremity* or *apex*:—presents centrally the posterior small orifice of the sacral canal with the last superior spine above it, and the flat facet for the 1st piece of the coccyx below it, and laterally the posterior notches and sacral cornua.

The Coccyx.

The *Coccygeal* or *caudal vertebræ* are false vertebræ, 13 to 18 in number, and except the first 3 or 4 are merely small bony masses. All of them are convex both anteriorly and posteriorly, and, except the first two or three, have no spinal canal. They form the skeleton of the tail and only the first 3 or 4 present some *typical* parts of a vertebra.

The Thorax.

Is a large anterior cavity of the trunk containing the principal organs of respiration and circulation. It is an Osseo-cartilaginous cage bounded superiorly by the dorsal vertebræ, inferiorly by the sternum, and laterally by the ribs and their cartilages. Its anterior aperture is triangular with the apex directed downwards and forwards, is bounded by the first dorsal vertebra, the first pair of ribs and the sternum, and gives passage to the trachea) wind-pipe), œsophagus, and several important blood-vessels and nerves. Its posterior aperture, oval and directed downwards and forwards, is formed by the last dorsal vertebra, the last pair of ribs, the cartilages of the false ribs and the Xiphoid cartilage, and its boundary gives attachment to the diaphragm, a large muscular partition separating the thorax from the abdomen.

The Ribs.

The eight anterior ribs are termed *Sternal* or *True ribs* as they have direct sternal attachments through their costal cartilages while the ten posterior are *Asternal* or *False ribs* which have in direct sternal attachments i. e., their costal cartilages join with th

cartilages of the preceding ribs only. The cartilage of the last true rib joins them with the sternum.

Common characters of the ribs :—

The *Superior extremity* presents a head, a neck and a postero-inferior tubercle. The *Inferior extremity* presents a shallow porous depression. The *Shaft* or *body* has a convex *external surface* (superiorly rough for muscular attachments), a concave smooth *internal surface* (covered by the pleura), a concave thin *anterior border*, and a convex thick *posterior border* grooved along its superior third for the intercostal nerves and blood vessels.

Specific characters of the ribs :—

The ribs increase in length from the 1st to the 9th and then progressively shorten. They gradually become wider and their grooves become more obvious from the first to the 8th, and then they become narrower and their grooves more indistinct upto the last. They also become more curved from the first to the last.

The Special ribs :—

The *First rib* is the shortest, strongest, and straightest, and has no groove on its posterior border, but presents 2 *grooves* on its external surface for the axillary artery and vein, a *tubercle* larger than the head, and a flat *inferior extremity*. Its costal cartilage is very short and thick.

The *Second rib* has the characters of the first rib in a less degree. The *last* or *posterior* 4 or 5 *ribs* are slender and much curved, and have the articular facets of their tubercles confounded with those of their heads.

The *Costal Cartilages*, 18 in number, decrease in thickness from the 1st to the last, but increase in length from the 1st to the 12th, and then again shorten. Those of the true ribs have smallest upper ends, and those of the false ribs have largest upper ends and tapering lower ends.

Sternum.

The *sternum* or *breast bone* is formed of 6, rarely 7, segments or *sternebræ* united by intervening cartilages in the young animal and by partial ossification in the adult. It offers for study :—

The *Superior surface* :—triangular and concave.

The two *lateral surfaces* (right and left) :—superiorly are 8 diarthrodial oval facets for the *Sternal* costal cartilages; centrally is attached the mediastinum; anteriorly rests on it the thymus gland; and posteriorly the fibrous pericardium and inferiorly the pectoral muscles are attached.

The two *lateral borders* separate the superior from the lateral surfaces, and the third, *inferior*, border between the lateral surfaces is a prominent ridge coated with cartilage.

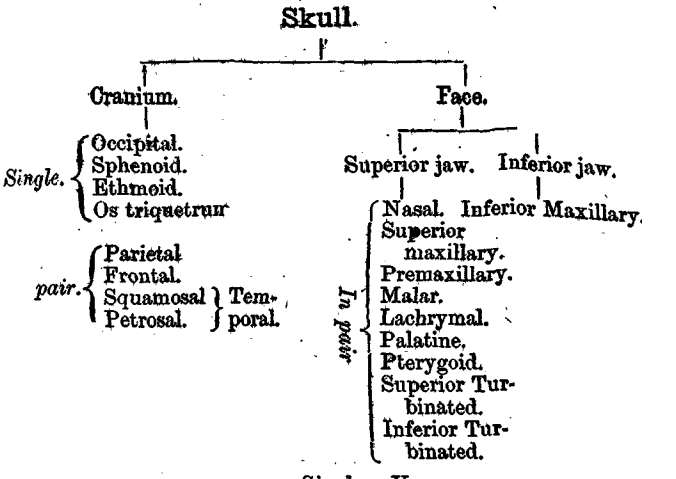
The *Anterior extremity* has a peculiar shape like the keel and cutwater of a boat, and is therefore termed the *cariniform* or *Keel-shaped cartilage*.

The *posterior extremity*, the *Xiphoid* or *Ensiform cartilage* is triangular, concave superiorly, and convex inferiorly.

The Skull.

The *skull* or skeleton of the head is composed of 32 bones (os hyoides not included),—six single and the rest in pairs—which, except the lower jaw and os-hyoides, become united by ossification in the adult animal. It consists of two parts viz.,—the *cranium* or *calvarium* and the *face*. The *cranium* is an irregularly ovoid cavity occupying the upper one-fifth of the skull and continuous with the spinal canal, and contains the brain and its appendages. The *face* is the lower four-fifths of the skull, contains several air-sinuses, and consists of the upper portion or superior jaw and the lower portion or inferior jaw. The *skull* articulates with the *Atlas* by its posterior extermity, its anterior extremity being free.

Tabular view of the bones of the skull.



Single:—Vomer.

The *skull* is a quadriangular pyramid containing various cavities. When placed *horizontally* it presents six regions viz., the *Superior*, *Inferior*, *2 Laterals* (*right and left*), *Anterior*, and *Posterior*.

The *Superior region* presents from *before backwards* :—

(1) The nasal peak, (2, 3, and 4) the nasal, frontal and parietal bones in pairs, and (5) the occipital crest.

The *Inferior region* is bounded below by the lower jaw, on the removal of which the following from *before backwards* are observed :—

(1) The *Premaxilla* with the upper *incisors* and *canines*, (2) the foramen *incisivum*, (3) the superior *interdental spaces*, (4) the bony palate or palatine processes of the Superior Maxillary, (5) the Wolf teeth, (6) the molar teeth, (7) the *palatine* grooves, (8) the

palatine foramina, (9) the *palatine* arch and palatine bones, (10) the posterior *nares*, (11) the vomer, (12) the *staphylline* grooves, (13) the Pterygoid bones, (14) the alveolar tuberosities, (15) the *zygoma* of the malar, (16) the *orbital* fossa, (17) the *temporal* fossa, (18) the presphenoid, (19) the *pterygoid processes* of the sphenoid, (20) the *pterygoid* or *subsphenoidal* foramina, (21) the *zygoma* of the squamosal with the *condyle*, *glenoid cavity*, and *anterior mastoid process* or *Supercondyloid* eminence, (22) the *alæ*-sphenoid (23) the basisphenoid, (24) the *carotid* notches, (25) the foramina *lacerii basis cranii*, (26) the *petrosal styloid* processes, (27) the *posterior mastoid* processes, (28) the Petrosal bones, (29) the basi-occipital or *basilar* process, (30) the *occipital styloid* processes, (31) the *stylo-condyloid* notches, (32) the *condyloid* foramina, and (33) the occipital *condyles*.

The *Lateral regions*, right and left, each presents from before backwards :—(1) the Premaxilla, (2) the superior maxilla, (3) the *infra orbital* foramen, (4) the *Maxillary spine*, (5) the Lachrymal bone, (6) the malar bone, (7) the zygomatic processes of the malar and squamosal bones forming the *Zygomatic arch*, (8) the orbital fossa with maxillary and orbital hiatii, (9) the external orbital process or *frontal arch*, (10) the temporal fossa, (11) the parietal ridge, (12) the external *auditory meatus*, and (13) the mastoid ridge. The inferior maxilla extends throughout inferiorly.

The *Posterior region* or the *base* presents from *above downwards* :—

(1) The occipital *crest*, (2) the *Mastoid ridges*, (3) the *Cervical tuberosity* or external occipital protuberance, (4) the foramen *Magnum*, (5) the occipital *condyles*, (6) the *stylo-condyloid* notches and (7) the *occipital styloid* processes.

The *Anterior region*, *apex* or *summit* of the skull presents :—(1) the anterior *nares*, (2) the premaxilla with the upper incisors, and (3) the body of the inferior maxilla with the lower incisors.

Cranial Bones.

Occipital. Wormian. Sphenoid. Ethmoid.	*Single.*	Parietal. Frontal. Temporal. (In the horse divided into 2 parts, the squamosal and petrosal).	*In pairs*

Occipital Bone.

Presents 4 distinct pieces in the yonng animal, which first unite into 2, and ultimately into one.

It has 2 surfaces and 3 borders.

1:—The External Surface, convex and divisible into 2 parts.

A:—The upper or *supra-occipital* presents superiorly (*a*) the *Occipital Crest*, posteriorly (*b*) the *Occipital* or *Cervical Tuberosity*, and laterally (*c*) the depressions for the cordiform part of the ligamentum nuchæ and (*d*) the occipital or *Mastoid ridges*.

B:—The lower or *Sub-occipital* presents (*a*) the *Foramen* Magnum for the passage of the spinal cord with its membranes, venous sinuses, the spinal accessory nerves, the meningeal and basilar arteries, and the long Odontoid ligaments, (*b*) the *occipital condyles* for the atlas, (*c*) the *basilar process* (basi-occipital bone), (*d*) the *basilar fissure* inferiorly, (*e*) the *Styloid processes* or *jugular eminences* externally, (*f*) the *condyloid* or *stylo-condyloid notches*, (*g*) the *condyloid* foramina for the 12th Cranial (Hypoglossal or lingual) nerve.

2:—The Internal or Cerebral surface, concave and divisible into two portions.

A:—The Supra-occipital presents the *Occipital Cupola* for the cerebellum.

B:—The sub-occipital presents (*a*) the inner circumference of the foramen magnum, (*b*) the *nutrient foramina*, (c) the *basilar*

fossa for the Pons Varolii and Medulla Oblongata, and *(d)* the internal orifices of the condyloid foramina.

1:—The *Superior border*, serrated for the parietal.

2 and 3:—The *Lateral borders* (right and left) articulate with the temporal bones, and anteriorly form the inner boundary of the *foramina lacerii basis cranii* or *Occipito-spheno-temporal hiatii*, which are divided in the living animal by a ligament into an *anterior* or *inferior lacerated* and a *posterior* or *superior lacerated* foramen; the anterior for the inferior maxillary division of the 5th, internal carotid and meningeal arteries, and a vein running from the cavernous sinus to the jugular vein, and the posterior for the glosso-pharyngeal, pneumogastric and spinal accessory nerves.

Wormian bone or Os Triquetrum.

Presents internally a bony prominence—the *Ossific Tentorium*—to which the falx cerebri is attached.

Sphenoid.

Placed between the occipital and ethmoid, resembles a bat with its wings extended and is divisible into two centre-pieces (*anterior* or *presphenoid* and *posterior* or *basi-sphenoid*) which together form the *body*, and two pairs of flattened processes or *wings* (*anterior* or *orbito-sphenoid* and *posterior* or *ali-sphenoid*).

Body has 2 surfaces and 2 broders.

1 :—The *superior* or *Internal surface* is concave and presents (a) the *Pituitary fossa* or *Sella Turcica* for the pituitary body or gland, (b) the slightly elevated *olivary process* for the optic commissure, (c) the transverse notch anteriorly, the *optic hiatus*, leading to (d) the two *optic foramina* for the optic nerves with their dense sheaths of dura mater, (e & f) on each side of the sella

turcica, two grooves—the *internal* or *Cavernous fossa* for the cavernous sinus and the ophthalmic, 3rd, and 6th cranial nerves, and the *external* or *Sphenoidal fossa* for the superior maxillary division of the 5th nerve, (g) the *foramen lacerum orbitale* inner and upper) for the alveolar vein, opthalmic artery, and the 3rd, 4th ?, ophthalmic division of the 5th, and 6th nerves, (h) the *foramen rotundum* (outer and lower) for the superior maxillary division of the 5th nerve, and (i) the *foramen patheticum* (at the base of the pterygoid process) for the 4th nerve or a few small vessels. G, h, and i are also called the three *supra-sphenoidal canals.*

2:—The *Inferior* or *External surface* is convex and presents (a) the *Pterygoid processes*, (b) laterally the *vidian fissures*, converted anteriorly into the *vidian canals* by the palatine bone for the vidian nerves, (c) supero-posteriorly the *pterygoid* or *subsphenoidal foramina*, bifurcating anteriorly into 2, the larger and inferior for the internal maxillary artery and the smaller and superior for the anterior deep temporal artery, (d) anteriorly the *orbital* or *sphenoidal hiatus* into which open the pterygoid, lacerum orbitale, rotundum and optic foramina, (e) more anteriorly the optic foramen, and (f) a notch near the anterior border of the body converted by the frontal into the *foramen orbitale* internum for the internal lateral nasal artery (branch of the ophthalmic), vein, and nerve.

1 :—The *posterior border* articulates with the basi-occipital.

2 :—The *Anterior border* presents the *Sphenoidal cells* separated by a thin bony plate.

Wings of the Sphenoid are two, each has 2 surfaces & 3 borders.

1 :—The *Internal surface* posteriorly concave for the cerebral mastoid lobes.

2 :—The *External surface* anteriorly convex and joins the frontal to form the orbital fossa, and posteriorly rough for the squamosal.

1 :—The *Posterior border* internally forms the anterior boundary of the foramen lacerum basis cranii, and presents 2 notches—the *Carotid notch* (internal) for the internal carotid artery and the *Inferior Maxillary* notch (external) for the inferior maxillary nerve (branch of the 5th).

2 :—The *Superior border* serrated for the squamosal.

3 :—The *Anterior border* articulates with the ethmoid wing.

Ethmoid.

Is a sieve-like bone, and consists of a *body* with 2 large anterior cavities—the *Ethmoidal sinuses, a perpendicular plate or lamella* continuous with the cartilaginous septum of the nose, anteriorly covered with pituitary membrane and posteriorly forming the *crista* galli process, and 2 *lateral parts* or *wings* in which are situated the *Ethmoid volutes* or *cells*. These cells and the nasal cavities are separated from the cranial cavity by thin transverse perforated plates (for the fibres of the olfactory nerves), the *cribriform plates*, which are posteriorly concave to form the *Ethmoidal or Olfactory fossæ* for the olfactory bulbs.

Parietal.

It has 2 surfaces and 4 borders.

1:—The *External surface* is convex and smooth and presents (a) a few *foramina* posteriorly for the meningeal arteries, (b) the curved *parietal ridge*, and (c) an external portion forming the temporal fossa.

2:—The *Internal Surface* is concave and presents (a) numerous *digital depressions* for the cerebral convolutions, (b) the *Longitudinal groove* along the junction for the longitudinal sinus of the dura mater, &(c)posteriorly the *transverse groove* for the transverse sinus.

1:—The *anterior border*, concave and serrated for the frontal.

2:—The *posterior border*, thick and dentated for the occipital externally and os triquetrum internally.

3:—The *External border*, anteriorly thin for the squamosal, centrally pointed for the sphenoid, and posteriorly thick for the petrosal.

4:—The *internal* border, dentated for the opposite parietal with which it forms the *sagittal suture*.

Frontal.

It has 2 surfaces and 4 borders.

1:—The *external surface*, concavo-convex, presents (a) the *external orbital process* or *Frontal arch* with (b) the *supra-orbital foramen* for the supraorbital artery, vein, and nerve, (c) the *internal orbital process* divided by (d) the *Incisura sphenoidalis* for the orbito-sphenoid, anterior to which is (e) a smaller notch converted by the sphenoid into the Internal orbital foramen, (f) superiorly the *hollow* for the lachrymal gland, & (g) the *depressed part* behind the frontal arch forming the temporal fossa.

2 :—The *internal surface* is concave and divided by the transverse *Cranial plate* into the posterior and anterior portions.

A :—the *Posterior part* presents (a) the *digital depressions* for the anterior cerebral convolutions, (b) a *furrow* for the anterior meningeal artery, & (c) the continuation of the longitudinal groove along the junction.

B :—the Anterior part forms (a) the *frontal sinus* and separated from its fellow by (b) the *nasal spine*.

The *posterior*, *anterior*, *external* and *internal borders* respectively articulate with the parietal and squamosal, the nasal and lachrymal, the lachrymal and sphenoid, and the frontal forming the frontal suture.

Temporal.

In the horse it is divided into the *Squamosal* or squamous temporal, and the *Petrosal* or petrous temporal.

Squamosal.

It has 2 surfaces and a circumference.

1 :—The external surface convex and presents :—

(a) *Numerous small foramina* for meningeal vessels, (b) the *Zygomatic process*, (c) inferiorly the *glenoid cavity* with anteriorly (d) the *anterior condyle* for the inferior maxillary condyle and posteriorly (e) the *anterior mastoid process* or *supracondyloid eminence* for limiting the motion of the joint backwards with (f) the *mastoid foramen*, and (g) postero-superiorly the *broad convex surface* forming the temporal fossa, having (h) the sharp *Zygomatic spine* postero-externally.

2 :—The internal or cerebral surface unequally divided by (a) the *deep vertical channel* converted by the parietal and petrosal bones into the *parieto-temporal conduit*, and presents anteriorly (b) the cerebral *digital impressions*.

The Circumference has 2 borders and an angle.

1 :—The superior border, convex, articulates with the parietal and frontal.

2 :—The inferior border joins with the sphenoid and presents a deep notch which receives the external auditory meatu

3 :—The posterior angle joins with the occipital.

Petrosal.

Is the hardest bone in the skeleton and *contains the organ of hearing*. It has 4 surfaces, 4 borders, a base, and an apex.

1 :—The anterior surface externally joins with the parietal and internally forms part of the cranial cavity.

2 :—The posterior surface joins with the occipital.

3 :—The External surface joins internally with the squamosal and externally with the occipital.

4 :—The Internal surface, concave, presents :—

(a) the *digital depressions* for the cerebellar convolutions, (b) the *internal auditory meatus*, (c) the short *internal auditory canal* for the (7th and 8th) auditory and facial motor nerves, and the auditory artery, (d) at its bottom *several small foramina* for the branches of the auditory nerve, separated by a thin bony plate from (e) the *origin* or *internal opening* of the *aqueduct of Fallopius* for the facial nerve, and (f) posteriorly to the internal meatus, the *aqueduct of the vestibule* for a small vein and artery, and the diverticulum of the membranous labyrinth (a process of dura mater).

The 4 borders separate the 4 surfaces.

The *border between the external and posterior surfaces* forms the *mastoid ridge* having the *posterior mastoid process* anteriorly, and is traversed by the *mastoid fissure* which ends in the parieto-temporal conduit.

The *border between the internal and anterior surfaces* marks the division between the cerebral and cerebellar cavities and to it is attached the tentorium cerebelli.

The Base presents :—

(a) the *external auditory meatus or canal and hiatus*, (b) the *external auditory process* for the annular aural cartilage, and (c) the small *hyoid or vaginal process* below the meatus, with posteriorly (d) the *stylomastoid foramen* (external orifice of the aqueduct of Fallopius), (e) inferiorly, the *mastiod protuberance* or *Auditory bulla* (little developed in the horse) containing the mastoid cells, and infero-anteriorly (f) the long *Styloid* or *subuliform process* for the tensor palati with supero-posteriorly (g) the *Glaserian fissure* for the chorda tympani nerve, infero-internally (h) the

opening for the Eustachian tube (g. and h. constitute the styloid foramen), (i) more internally, the *ridge* forming the externa boundary of the foramen lacerum basis cranii.

The *apex*, dentated and pointed for the occipital.

Facial bones.

In pairs.
- Nasal.
- Superior Maxillary.
- Premaxillary.
- Malar.
- Lachrymal.
- Palatine.
- Pterygoid.
- Superior Turbinal.
- Inferior Turbinal.

Single :—Vomer.

} FORM THE UPPER

Single :—Inferior Maxillary.....FORMS THE LOWER JAW.

Nasal Bone.

It has 2 surfaces, 2 borders, a base, and an apex.

1:—The SUPERIOR or EXTERNAL SURFACE—smooth, convex, and subcutaneous.

2:—The INFERIOR or INTERNAL SURFACE, concave forming the nasal roof, and presents (a) externally, the *vertical ridge* for the superior turbinal, (b) the *superior nasal meatus*, (c) posteriorly, the concave *nasal portion* of the frontal sinus, (d) internally, the *ridge* converted into a groove for the cartilaginous septum nasi by its fellow.

1:—The EXTERNAL BORDER, thin, posteriorly articulates with the lachrymal, superior maxilla, and premaxilla, and anteriorly forms part of the *anterior nares*.

2:—The INTERNAL BORDER—straight, articulates with its fellow.

The BASE, convex and serrated for the frontal.

The APEX, forms with its fellow the *nasal peak*.

Turbinals.

Consist of very delicate and reticulated bony convolutions.

The SUPERIOR or ETHMOIDAL TURBINAL is attached to the inner *nasal ridge* and the ethmoid, and is posteriorly continuous with the frontal sinus.

The INFERIOR or MAXILLARY TURBINAL is attached to the inner ridge of the superior maxillary, and is anteriorly continuous with the maxillary sinus. They both are devoid of periosteum, and are covered by the nasal mucous membrane. They divide the nasal fossa into three meatuses on each side, viz. (a) the *Superior meatus*, between the superior turbinal and nasal roof, (b) the *middle meatus*, between the two turbinals, and (c) the *inferior meatus*, between the inferior turbinal and the nasal floor.

Superior Maxilla.

Has 3 surfaces, 3 borders, and 2 extremities.

1:—The EXTERNAL or FACIAL SURFACE is convex, and presents (a) the *Maxillary spine*, (b) the *Infra-orbital foramen* for the dental branch of the superior maxillary division of the 5th nerve, and the superior dental artery, (c) the remaining portion for the masticatory and other muscles.

2:—The INTERNAL or NASAL SURFACE is concave and presents (a) the *Internal maxillary spine* for the inferior turbinal, (b) posteriorly, the *maxillary sinus*, (c) the *fissure* converted by one in the palatine bone into the *palatine foramen* for the palatine artery, & (d) the *inferior lachrymal foramen* with a shallow fissure for the lachrymal duct.

3:—The INFERIOR or PALATINE SURFACE presents (a) the *palatine process* for separating the nasal fossæ from the cavity of the mouth, (b) the *palatine groove* for the palatine artery, and (c) the numerous small grooves and foramina.

1:—The SUPERIOR BORDER is thin and articulates anteriorly with the nasal and premaxilla, and posteriorly with the lachrymal and malar.

2:—The INTERNAL BORDER is anteriorly notched to form the foramen incisivum and articulates with its fellow, and posteriorly with the palatine bone.

3:—The INFERIOR BORDER is very thick and presents (a) a part of the superior interdental space, (b) six *alveoli* for the upper molars, (c) a small alveolus for the premolar or wolf's tooth, and (d) the *alveolar tuberosity*.

1:—The POSTERIOR EXTREMITY forms, (a) the *alveolar* tuberosity, in which the maxillary sinus is prolonged and internal to it is (b) a large deep excavation converted by the palatine bone into the *Maxillary hiatus* which contains 3 foramina, (1) the *Palatine* or *Palato-maxillary foramen* for the palatine artery, (2) the *Dental foramen* for the superior dental artery, (3) the *Spheno-palatine* or *nasal* foramen for the spheno-palatine artery, vein and nerve.

2:—The ANTERIOR EXTREMITY presents, in the male, the *demi-alveolus* for the canine tooth.

Premaxilla.

Also called the *Intermaxillary* or *anterior maxillary* or *Incisive* bone, consists of a base and 2 processes.

The BASE has 3 surfaces and 3 borders.

1:—The *External* or *Labial surface*, smooth and convex.

2 :—The *Internal* surfaces denticulated for its fellow, and is traversed by a groove converted by one on its fellow into the *Incisive canal* and *Foramen Incisivum* for the palato-labial artery.

3 :—The *Inferior* or *buccal* surface, concave, presents the continuation of the palatine groove and is lined by the buccal mucous membrane.

1 and 2 The *Superior, and inferior, internal borders* which separate the internal surface from the external and inferior surfaces respectively.

3 :—The *External border* very thick and presents (a) three *alveoli* for the incisors, (b) a part of the *superior interdental space*, and (c) the *demi-alveolus* for the canine tooth (in the male).

1 :—The EXTERNAL PROCESS, larger and longer, presents a convex *external surface*, a smooth *internal surface* covered by the nasal mucous membrane, a smooth rounded *superior border*, a denticulated *inferior border* for the superior maxilla, and a posterior *summit* which is wedged in between the superior maxilla and nasal.

2 :—The INTERNAL or PALATINE PROCESS has a *superior* and an *inferior* surface forming part of the nasal floor, and hard palate, respectively, and joins internally with its fellow.

Malar Bone.

Also called the *Zygomatic* or *Jugal* bone, presents (a) the convex *external* or *facial surface*, (b) the concave *internal* or *maxillary surface* forming part of the Maxillary sinus, (c) the concave *superior* or *abital surface* forming part of the orbital fossa, (d) the *anterior base* articulating with the superior maxilla and lachrymal, and (e) the *posterior apex* or *Zygomatic process* forming the Zygomatic arch with the squamosal Zygomatic process,

Lachrymal Bone.

Has (a) the convex *external* or *facial surface* with the *Lachrymal tubercle* postero-centrally, (b) the doubly—concave *internal surface* forming the floor of the frontal, and the roof of the Maxillary, sinuses, (c) the cancave *posterior* or *orbital surface* with the central *lachrymal fossa* for the lachrymal sac, and the *orifice* of the *lachrymal duct*, (d) the denticulated *circumference* for the frontal, nasal, superior maxillary, and malar bones.

Palatine Bone

Has 4 surfaces and 2 extremities.

1 :—The *External* or *Orbital surface* presents (a) a concave smooth posterior part for the orbital fossa, (b) anteriorly, a denticulated part for the superior maxilla, (c) externally, the *staphylline groove* for the staphylline artery and nerve and the palatine vein, and (d) centrally, the *palatine groove* converted by the superior maxilla into the *palatine foramen.*

2 :—The *Inferior* or *palatine surface*, concave and very narrow forming the *demi-palatine arch.*

3 :—The *Internal* or *Nasal surface*, concave and articulating with its fellow anteriorly, and with the pterygoid bone posteriorly.

4 :—The *Superior* or *Sphenoidal* surface concave forming part of the sphenoidal sinus, and posteriorly is the *Palatine ridge* for the vomer.

1 :—The *Anterior extremity* flat, and curved inwards for its fellow and the palatine process of the superior maxilla, and presents a *deep notch*, often converted into the *nasal foramen.*

2 :—The *Posterior extremity* thin and presents externally depression for the spheno-pterygoid process.

Between the two palatine bones is the space called the *posterior nares*, its circumference being termed the *palatine arch* for the velum pendulum palati (Soft palate).

Pterygoid Bone.

Has 2 surfaces and 2 extremities.

1 :—The *External surface* articulates with the palatine bone and spheno-pterygoid process.

2 :—The *Internal surface* lined by the pharyngeal mucous membrane.

1 :—The *anterior extremity* has the *Hamular process* grooved for the gliding of the tensor palati tendon.

2 :—The *Posterior extremity* forms part of the *Vidian* canal for the vidian nerve.

Vomer.

Has 2 surfaces, 2 borders, and 2 extremities.

1 and 2 :—The *right* and *left lateral* surfaces covered by the *Schneidevian* (nasal) mucous membrane.

1 :—The *superior border* deeply grooved for the cartilaginous septum nasi.

2 :—The *inferior border* posteriorly divides the *posterior nares*, and anteriorly articulates with both superior maxillæ.

1 :—The *Anterior extremity* or *apex* rests on the palatine processes of the premaxillæ.

2 :—The Posterior extremity articulates with the palatine, pterygoid, ethmoid, and sphenoid bones, and presents a central *notch* for the blood-vessels and nerves to supply the septum nasi.

Inferior Maxilla.

Also called the *Mandible*, or *Lower jaw*. It is composed of two branches or *rami* united together anteriorly and leaving a triangular gap, the *Intermaxillary space*, between.

In the adult the anterior union is complete but in the fœtus the two branches are distinct pieces, each of which has 2 surfaces, 2 borders, and 2 extremities.

1 :—The EXTERNAL SURFACE, anteriorly smooth, and posteriorly rough for the masseter muscle.

2 :—The INTERNAL SURFACE presents from before backwards, (a) the *genial surface*, (b) the *myloid ridge* for the mylo-hyoideus, (c) the *groove* for the buccal membrane, (d) the *Inferior* (Posterior) *Maxillary* or *Inferior dental foramen* for the inferior dental artery, vein, and nerve, and (e) the *rough excavation* for the pterygoid muscles.

1 :—The SUPERIOR OR ALVEOLAR BORDER presents an *anterior straight* portion containing six alveoli for the lower molars and one for the Wolf's tooth, and a rough *concave posterior* portion for muscles.

2 :—The INFERIOR BORDER is thick and rounded in the young animal but becomes thinner and sharper with age, and presents an *anterior straight* portion and a *posterior convex* one, seperated by the oblique transverse *Maxillary fissure* for the glosso-facial or submaxillary artery and the *angle of the jaw*.

1 :—The POSTERIOR EXTREMITY has (a) anteriorly, the *coronoid process*, (b) posteriorly, the *condyle* with its *neck* for the articulation with the squamosal, and (c) centrally, the *Sigmoid* or *Corono-condyloid notch*.

2 :—The ANTERIOR EXTREMITY joins with that of the opposite side forming the *body of the inferior Maxilla*, and presents (a) the concave *Superior* (Internal) or *buccal surface* for the buccal mucous membrane and frenum linguæ, (b)

the convex *inferior* (external) or *labial surface* for the gums and labial muscles with the *anterior maxillary, mental* or *labial foramen* for the inferior dental vessels and nerve, (c) the *external border* presenting 3 *alveoli* for the lower incisors, the *inferior diastema* (interdental space), and the *alveolus for the tush* (canine tooth), and (d) the *internal border* uniting with its fellow to form the *maxillary symphysis.*

Os Hyoides.

Is a series of bones which support the tongue, pharynx, and larynx, and consist of 5 distinct pieces, a *body*, 2 greater horns or *cornua* and 2 lesser horns or *cornicula.*

The Body resembles a spur or two-spiked fork, and presents (a) the *Middle portion*, (b) the two *posterior* or *heel processes* or *thyroid cornua* (the thyro-hyals), and (c) the *anterior appendix* or *spur process* (glosso-hyal).

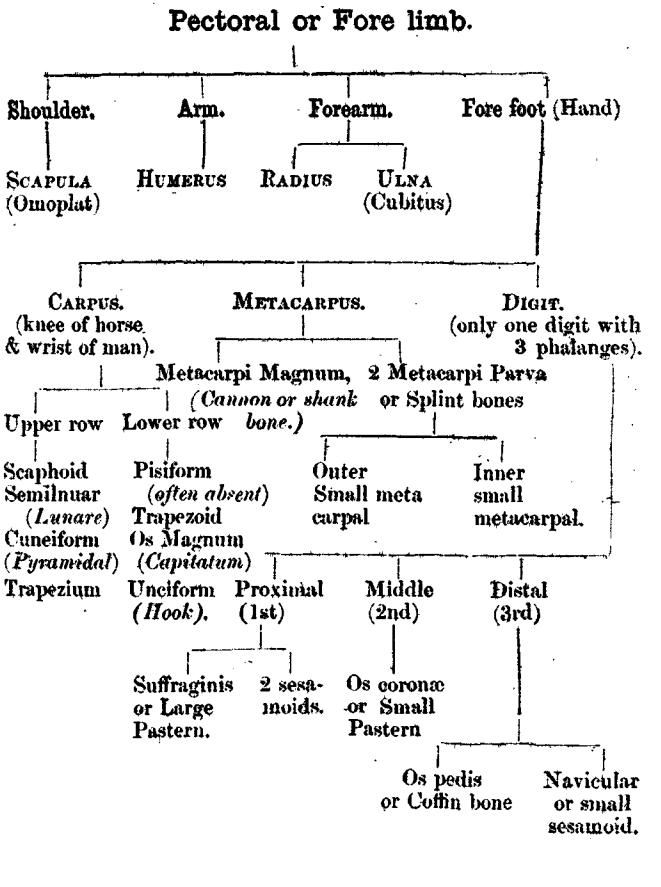
Two *Cornicula, styloid cornua* or *Cerato hyals* are cylindrical, articulating with the body inferiorly and the cornua superiorly.

Two *Cornua Styloid bones* (processes) or *stylo-hyals* are long and flat, having between them the alimentary and respiratory canals, articulating inferiorly with the cornicula, and uniting superiorly with the petrosal hyoid processes by means of fibrocartilages.

Appendicular Skeleton.

Consists of 4 limbs, two *anterior, fore, thoracic* or *pectoral* limbs, and two *posterior, hind* or *pelvic* limbs. In Solipeds, Ruminants, and Pig the anterior limbs are attached to the trunk by the muscles only, there being no *articular* or *bony* connection, and hence in them the *pectoral arch is incomplete.* In Carnivora the *Pectoral arch* or *shoulder girdle is complete* as the fore-limbs articulate with the trunk by means of *clavicles* or *collar-bones* (one on each side) which are absent in other domesticated animals. The *hind limbs* articulate with the sacrum and thus form a *complete pelvic arch* in all domesticated animals.

THE TABULAR VIEW OF THE BONES ENTERING INTO THE FORMATION OF THE FORE LIMB OF THE HORSE.



Scapula.

Has 2 surfaces, 3 borders and 3 angles.

(1):—The EXTERNAL SURFACE or DORSUM presents (a) the *spine* with the central *tubercle* or *tuberosity of the spine*, (b) the small *antea (supra) spinatus fossa* for the antea spinatus muscle, (c) the large *postea (infra) spinatus fossa* for the postea spinatus muscle, (d) near the neck, the *groove* for a branch of the Posterior scapular artery, and (e) the *nutrient foramen* for the nutrient or medullary vessels.

(2). The INTERNAL or VENTER SURFACE presents (a) the *Subscapular fossa* for the subscapularis muscle, and (b) *two rough triangular spaces* for the serratus magnus.

(1):—The *anterior border* thin, sharp, convexo-concave with an inferior large bent process the *Coracoid apophysis*, which in some animals is a separate bone, and above which run the dorsalis scapular artery, vein, and nerve from within outwards.

2:—The *posterior border* concave and thick for muscular attachments.

3:—The *Superior border* indented and grooved for the broad *cartilage of prolongation* to which several muscles are attached.

1:—The *Anterior* or *Cervicle angle* is thin.

2:—The *posterior* or *dorsal angle* is thick.

3:—The *Inferior* or *humeral angle* presents the *neck* and the *glenoid cavity* for the humeral head notched internally for blood-vessels.

Humerus.

Has a body or shaft and two extremities.

The Shaft is twisted and has 4 surfaces:—

1:—The ANTERIOR SURFACE triangular and rough between its middle and inerior third for the caraco humeralis.

2 :—The POSTERIOR SURFACE round and smooth, and having inferiorly an external ridge or *epitrochlea* and an internal ridge or *Epicondyle*, between which is the *Olecranon fossa.*

3 :—The EXTERNAL SURFACE presents the *furrow of torsion* (musculo-spiral groove) for the humeralis obliquus with its prominent *anterior crest* or *deltoid ridge* (which has on its upper third the *external* or *deltoid tuberosity*), and its *posterior crest.*

4 :—The *internal surface*, indistinct, presents about its middle the *internal tuberosity*, and at its inferior third the nutrient foramen for the nutrient vessels.

1 :—The SUPERIOR or PROXIMAL EXTREMITY presents (a) the convex posterior *head*, (b) the *neck* or Cervix, (c) several foramina for the blood-vessels for the internal cancellous tissue, (d) the *External trochanter* with its (anterior) *summit*, and (posterior) *convexity*, (e) the *internal trochanter* with its *anterior*, *posterior* and *inferior parts*, and (f) the *bicipital groove*, between the two trochanters, consisting of two vertical grooves with a median ridge or tubercle, covered with fibro-cartilage and a large bursa for the gliding of flexor brachii tendon.

2 :—The INFERIOR or DISTAL EXTREMITY presents (a) the *internal condyle*, (b) the *external trochlea*, (c) the *median groove* separating them, (d) the anterior shallow *coronoid fossa*, for the radial coronoid process, (e) the posterior deep *olecranon* or *supra condyloid fossa* for the ulnar olecranon (hamular) process, and (f) the *external depresion* or *pit* and (g) the *internal eminence* for the external and internal lateral ligaments respectively.

Radius.

The Radius and Ulna, the bones of the forearm, in the adult become ossified and form one bone-the os antibrachii.

The Radius has a SHAFT and 2 EXTREMITIES.

The **Shaft** has 2 surfaces and 2 borders.

1 :—The *anterior surface* smooth, convex and covered by the extensor muscles.

2 :—The *posterior surface* concave, covered by the flexor muscles and presents from above downwards, (a) the *wide shallow groove*, forming with that on the ulna, the radio-ulnar arch for the interosseous artery (branch of the posterior radial), vein and nerve; (b) the *nutrient foramen*, and (c) the *narrow elongated triangular surface* externally for the ulna.

The two borders (external and internal) are thick and rounded.

1 :—The SUPERIOR EXTREMITY presents (a) two *glenoid cavities* (inner larger) for the humeral condyles, (b) antero-centrally, the *coronoid process*, (c) antero-internally, the *Bicipital tuberosity*, (d) the prominent *external tuberosity*, (e) posteriorly two *facets* and a *rough surface* for the ulna, and (f) the *rough lateral portions* for the lateral ligaments.

2 :—The INFERIOR EXTREMITY presents (a) the articular surface with *three facets* for the upper carpals, (b) three *anterior grooves* for the tendons, (c) the *lateral tuberosities* for the lateral ligaments, the inner prominent and the outer grooved for the tendon, and (d) the posterior transverse *ridge* for the posterior annular ligament.

Ulna.

Has a SHAFT and 2 EXTREMITIES.

The SHAFT has 3 surfaces and 3 borders.

1 and 2 :—The *external* and *internal surfaces* smooth, but plane and hollowed respectively.

3 :—The *anterior surface* presents from above downwards (a) the *two facets*, (b) the *small rough surface* (c) the *groove* for the radio-ulnar arch, and (d) the *triangular rough surface* for the radius.

1 and 2 :—The *external* and *internal borders* thin.

3 :—The *posterior border* thick and concave.

1 :—The SUPERIOR EXTREMITY or OLECRANON PROCESS presents a) the convex *external surface*, (b) the excavated *internal surface* (c) the concave smooth *posterior border*, (d) the concave *anterior border* with (e) the Beak (hamular process) of the olecranon, and (f) the crescentic *sigmoid notch*, and (g) the *summit of the olecranon* for the triceps extensor brachii.

2 :—The INFERIOR EXTREMITY tapers into a knob—the *capitulum ulnæ*—and extends to the lower fourth of the radius. (In the ass and mule it reaches the inferior radial extremity).

The development of the ulna is in direct ratio with the number of digits, thus it is shorter in the horse which nas only one digit than in the ox, dog, and pig.

The Fore foot.

The fore-foot or hand is the region which presents the greatest differences in various animals and includes three divisions (1) the *carpus*, (2) *the metacarpus*, and (3) the *phalangeal* or *Digital region.*

Carpus.

The CARPUS, WRIST, or KNEE consists of 7 or 8 bones arranged into two rows. From within outwards they are :—

(upper row) The *scaphoid*, the *lunare*, the *cuneiform*, and the *trapezium.*

(lower row) the *pisiform* (often absent), the *trapezoid*, the *os magnum*, and the *unciform.*

Scaphoid.

Has 6 surfaces.

The *anterior* and *internal* are convex and continuous, the *superior* and *inferior* are articulatory and concavo-convex, the *external* excavated and has 3 facets for the lunare, and the *posterior* is tuberous.

Lunare.

Has an anterior *base*, a posterior tuberous *apex* and 4 articular surfaces. The superior posteriorly concave, the inferior concavo-convex, the external with two facets, and the internal excavated and has three facets.

Cuneiform.

Has 5 surfaces, the *superior* deeply concave, the *inferior* somewhat concave, the *external* convex, the *internal* with 2 facets, and the *posterior* has one facet.

Trapezium.

Has 2 *surfaces* and a *circumference*.

The *external surface* convex, the *internal surface* concave and grooved for the flexor metacarpi externus tendon. The circumference has a facet anteriorly.

Pisiform.

Is pea-shaped, very small, and often absent.

Trapezoid.

Has a posterior *base*, an anterior *apex*, and 4 surfaces.

The *Superior surface* smooth and rounded, the *inferior* with two facets, the *external* rough and with 3 facets, and the *internal* convex, rough and non-articular.

Os Magnum.

Has an anterior *base*, a posterior blunt *apex*, and 4 articular surfaces.

The *superior surface* concavo-convex, the *inferior* flat, the *internal* with 3 facets, and the *external* with 2 facets.

Unciform.

Has an anterior *base*, a posterior *apex* or *unciform process* and 4 surfaces. The *superior surface* convex and smooth, the *inferior* with 3 facets, the *internal* with 2 facets, and the *external* narrow.

Metacarpus.

Consists of 3 bones, one central, the *large metacarpal*, and two laterals, the *outer* and *inner small metacarpals.*

Os Metacarpi Magnum.

Also called the *principal metacarpal*, *Cannon*, or *Shank* bone.

It has a SHAFT and 2 EXTREMITIES.

The SHAFT presents (a) the smooth convex *anterior surface*, (b) the flat rough *posterior surface*, for the suspensory ligament having the *nutrient foramen* at its upper third, and two *rough surfaces*, laterally, for the interosseous ligaments (often ossified in old horses) and splint bones, and the articular foramina inferiorly, and (c and d) the thick round *external* and *internal borders.*

1:—The SUPERIOR EXTREMITY presents (a) *Four facets* for 3 lower carpals, superiorly (2 for the unciform), (b) the *tuberosity* for the Extensor metacarpi magnus, antero-internally, (c) *four facets in 2 pairs* for the splint bones posteriorly.

2:—The INFERIOR EXTREMITY has two *condyles* (inner larger) with a median prominent *ridge.*

Ossa Metacarpi Parva.

Also termed *splint bones*, and are *outer* and *inner.*

They are attached postero-laterally to the cannon bone by interosseous ligaments which become ossified in old animals. They vary in length in different animals, and are generally two-thirds of the cannon bone. Each has a SHAFT and 2 EXTREMITIES.

The SHAFT presents (a) the smooth round *external surface*, (b) the smooth flat *internal surface*, and (c) the rough articular *anterior surface* separated from each other by *three borders* (external internal and posterior).

1 :—The SUPERIOR EXTREMITY, *Head*, or *Base* has, 1,2 or 3 *carpal* facets, and 2 *metacarpal* facets.

2 :—The INFERIOR EXTREMITY or *apex* ends in a knob—the *button*—which is not attached to the cannon bone in health and is mistaken for *splints* which are bony growths between the large and small Metacarpals.

The inner splint-bone is thicker and longer than the outer and has on its head 2 or 3 (when pisiform present) *carpal* facets, while the outer has only 1 *carpal* facet on its head.

Digit.

The *Horse* has only *one digit* with *3 phalanges* placed one below the other. The first or proximal phalanx has 3 bones (Large Pastern and 2 sesamoids), the second or median has one bone (os coronæ), and the third or distal has two bones (os pedis and navicular).

Large Pastern.

Is also called the *os suffraginis* and has a SHAFT and 2 EXTREMITIES.

The SHAFT presents (a) the smooth convex *anterior surface*, (b) the rough flat *posterior surface* with *two ridges* for the middle inferior sesamoidean ligament, (c and d) the thick rounded *external* and *internal borders* (digital vessels and nerves lie in their contact).

1 :—The SUPERIOR EXTREMITY larger, and presents 2 *triangular cavities* separated by a *median groove* for the cannon bone, and 2 postero-lateral tubercles for the deep inferior sesamoidean ligament.

2 :—The INFERIOR EXTREMITY has 2 *condyles* (inner larger) with a *central groove* for the os coronæ, anteriorly an *eminence* for the extrensor pedis tendon, posteriorly a depression for the posterior prominence of the os coronæ, and laterally rough pits for the lateral ligaments.

Great Sesamoid bones.

Are two small triangular bones with their *bases* downwards and have concave *articular* anterior surfaces, convex posterior surfaces which, when together, form a groove for the flexor pedis perforans and perforatus tendons.

Small Pastern.

Also termed the *Os Coronæ*, has 4 surfaces and 2 borders.

The *Superior Surfac* presents 2 glenoid cavities with a median ridge, having anterior and posterior eminences, for the large pastern.

The *Interior Surface* has 2 condyles (inner larger) with a median groove for the os pedis and navicular.

The *Anterior Surface* is convex and rough for the extensor pedis tendon.

The *Posterior surface* is excavated and superiorly has a gliding surface for the flexor pedis perforans, the perforatus being inserted on its either side.

The *external* and *internal borders* are rough for ligaments.

Coffin Bone or Os Pedis.

Has 3 surfaces, 3 borders and 2 lateral angles or wings.

1 :—The ANTERIOR SURFACE or *Wall*, convex and semicircular, presents (a) numerous foramina for the blood-vessels and nerves, (b) numerous depressions for the soft structures of the foot, (c) the horizontal *preplantar groove*, on each side, for the lateral laminal artery and below it, (d) the *patilobe eminence.*

2 :—The INFERIOR SURFACE is divided by the *semlilunar* crest into an *anterior part* or *sole* perforated with foramina, and a

posterior part or *tendinous surface*, which has (a) the antero-central *depression* for the flexor pedis perforans tendon, (b) laterally the *plantar grooves* terminating into the *plantar foramina* for the plantar vessels and nerves, and (c) the posterior *rough surface* for the inferior navicular ligament.

3 :—The SUPERIOR or ARTICULAR SURFACE has 2 *glenoid* cavities with a median ridge for the os coronæ.

1 :—The convex *superior border* has central *Coronal* or *Pyramidal eminence* with 2 *lateral depressions* for the anterior lateral ligaments.

2 :—The *Inferior border* is thin, crescentic and perforated.

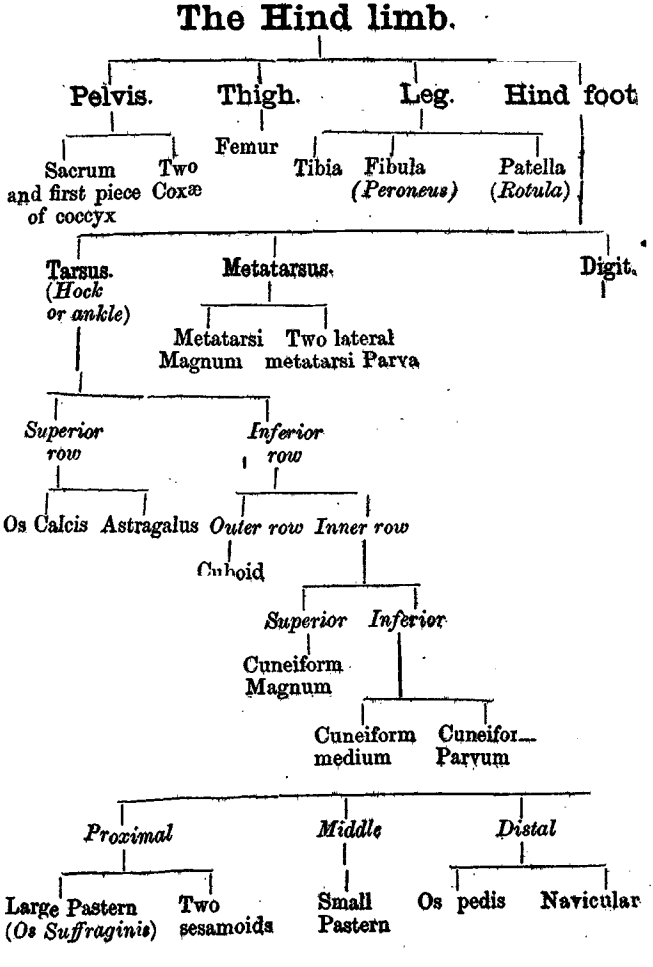
3 :—The concave *posterior border* has a narrow triangular facet for the navicular.

The ALÆ or WINGS are external and internal, each presenting (a) the *preplantar notch*, converted into foramen in old animals, for the lateral laminal artery, (b) the inferior *retrossal process*, and (c) the superior *basilar process* for the lateral cartilage which when ossified forms "*side bone.*"

Os Naviculare.

Also called the *small sesamoid* or *shuttle bone*, forms, with the os coronæ and os pedis, the *coffin joint*. It has (a) the smooth *superior surface* having 2 concavities and a central ridge for the os coronæ, (b) the rough *inferior surface* having 2 concavities and a median ridge covered by fibrocartilage for the gliding of the flexor perforans tendon, (c) the *anterior border* having a superior triangular surface for the os pedis and an inferior rough for the inferior navicular ligament, (d) the rough porous *posterior border* for the superior navicular ligament, and (e and f) two pointed extremities for the lateral navicular ligaments.

The table showing the regions with their bones of the *posterior pelvic, abdominal* or *hind* limb.



Pelvis.

Is a bony cavity formed by the sacrum and first piece of the coccyx superiorly and the two coxæ or ossa innominata supero-latero-inferiorly, and presents several apertures.

1:—The *Inlet, Anterior opening* or *Brim of the pelvis* is ovoid and bounded superiorly by the Sacral Promontory, laterally by the ilio-pectineal lines, and inferiorly by the Pubic Crest and Symphysis. Its transverse diameter ($8\frac{2}{5}$ in long from one pectineal eminence to another) is a little more than the vertical or sacro-pubic ($8\frac{1}{4}$ in. long from the sacral promontory te the pubic symphysis).

2:—The *Outlet* or *Posterior aperture* is triangular and bounded superiorly, at its apex, by the first coccygeal bone, laterally by the sacrosciatic ligaments, and inferiorly by the ischia and ischiatic spines. Its transverse diameter ($7\frac{7}{10}$ in. long from one superior ischiatic spine to another) is more than the vertical ($6\frac{7}{10}$ in. long from the first coccygeal piece to the ischiatic symphysis).

3:—The *Foramen ovale* or the *obturator* or *thyroid foramen* is oval and formed by the pubis and ischium of each coxa.

Female pelvis.

The pelvis of the mare differs much from that of the male horse and the differences are as follows:—

In the *mare pelvis* (a) the *transverse diameters* are much larger (b) the *sciatic notches* deeper and smoother, (c) the *ischial arch* wider and more obtuse, (d) the *obturator foramina* larger and

more circular, (e) the *cotyloid cavities* wider apart, (f) the *pelvic capacity* greater, and (g) the entire pelvis larger than in the horse pelvis.

The table showing the average diameters in inches of the horse and mare pelves.

Horse.		Mare.	
Transverse diameters.		Trasverse diameters.	
Outlet.	*Inlet.*	*Outlet.*	*Inlet.*
$6\frac{2}{5}$	$8\frac{1}{4}$	$7\frac{1}{2}$	$9\frac{1}{5}$

Horse.		Mare.	
Vertical diameters.		Vertical diameters.	
Outlet.	*Inlet.*	*Outlet.*	*Inlet*
$6\frac{3}{10}$	8	$6\frac{9}{10}$	$8\frac{9}{10}$

Ossa Innominata or the Coxæ.

In the fœtus and very young animals each os innominatum consists of three distinct pieces,—the *ilium*, *ischium* and *pubis*, which join in the *cotyloid* cavity or *acetabulum*.

Ilium.

Is the triangular anterior part of the coxa having 2 *surfaces*, 3 *borders* and 3 *angles*.

1:—The EXTERNAL (superior) SURFACE or the DORSUM is concavo-convex and rough for the gluteii and rectus femoris muscles.

2:—The INTERNAL (inferior) SURFACE or the VENTER is convex and presents (a) the *outer smooth part* (Iliac fossa) for the iliacus, (b) the *inner rough part* for the sacrum posteriorly and the inferior sacro-iliac ligament anteriorly, (c) the depression in front of the acetabulum for the rectus femoris (inner head), (d) the *ilio-pectineal eminence* for the psoas parvus, (e) internally the *groove* for the obturator vessels, and (f) inferiorly the *ridge* forming the *linea ilio-pectinea* with the anterior brim of the pubis, which separates the true from the false pelvis.

1:—The ANTERIOR BORDER or CREST OF THE ILIUM is concavo-convex and rough for muscles, and has posteriorly (internally) the *posterior iliac spine* (internal angle) and anteriorly (externally) the *anterior iliac spine* (external angle) for the abdominal muscles. The latter consists of 2 superior and 2 inferior eminences which project much in some horses forming "*ragged hips.*"

2:—The INFERIOR (external) BORDER concave, grooved for the obturator vessels and presenting the *nutrient foramen.*

3:—The SUPERIOR (internal) BORDER forms the *great Sciatic Notch* and presents the *Superior Ischiatic spine* or the *Supra-cotyloid crest* for the sacro-sciatic ligament.

The THREE ANGLES are the *external* (angle of the hanuch), the internal (angle of the croup) and the *postero*—inferior (cotyloid angle) forming part of the *cotyloid cavity* or *acetabulum*, for the femur head, which inferiorly presents the *cotyloid notch* and at its bottom the *fundus acetabuli* for the ligamentum teres.

Ischium.

Is the posterior quadrilateral part of the coxa presenting *a body* and a *ramus*.

The BODY OR SHAFT has 2 *surfaces* and 4 *borders*.

1 :—The smooth *superior surface* forms part of the pelvic floor and presents the nutrient foramen.

2 :—The concave rough *inferior surface* for several muscles.

1 :—The concave *anterior border* forms the posterior part of the obturator foramen.

2 :—The straight *posterior border* forms internally with its fellow the *Ischial arch* (for the crura of the penis in the male) and has externally the *Ischiatic Tuberosity* (for several muscles) from which antero-inferiorly runs the *inferior ischiatic spine* for the ischio femoralis.

3 :—The concave *external border* forms the *Lesser sciatic notch*.

4 :—The straight *Internal border* forms with its fellow the *Symphysis Ischii*.

The RAMUS (not well developed in the horse) joins with that of the pubis to form the internal boundary of the *obturator foramen*.

Pubis.

Is the antero-inferior triangular part of the coxa presenting a *body* and a *ramus*.

The BODY has (a) the concave *superior surface* for the bladder, (b) the convex grooved INFERIOR SURFACE for the pubio-femoral ligament and a large vein, (c) the thin *anterior border* (crest or brim of the pubis) with the *Pectinean tubercle* for the pectineus, (d) the concave *posterior border* forming the anterior margin of

the obturator foramen and grooved for the obturator vessels, and (e) the *internal border* forming with its fellow the *pubic Symphysis*. (It with the Symphysis ischii forms the *pelvic Symphysis*).

The RAMUS forms with that of the Ischium the internal boundary of the obturator foramen.

Femur.

The *Os femoris* or *thigh bone* has a *body* or *shaft* and 2 *extermities*.

The BODY or SHAFT has 2 surfaces and 2 borders.

1 :—The ANTERIOR SURFACE is convex and marked with a few muscular imprints.

2 :—The POSTERIOR SURFACE is flat and rough for abductor and adductor muscles and has at its inferior third the *groove* for the femoral artery and vein.

1 :—The EXTERNAL BORDER presents from above downwards (a) the Subtrochanterian crest, or the prominent *Trochanter Minor Externus* for the gluteus and vastus externii, and (b) the deep *supracondyloid fossa* (for the gastrocnemius internus) bounded externally by (c) the Supracondyloid crest (for the gastrocnemius externus).

2 :—The INTERNAL BORDER presents from above downwards (a) the *ridge* for the vastus internus, (b) the *Trochanter Minor Internus* for the psoas Magnus and iliacus, (c) the *ridge* for the pectineus and biceps adductor femoris and (d) the nutrient foramen.

1 :—The SUPERIOR EXTREMITY presents internally (a) the *head* for the cotyloid cavity with (b) the *neck* (not well marked in solipeds) and (c) the *deep notch* for the pubio-femoral and teres ligaments, externally, (d) the *Trochanter Major*

with (e) the posterior *summit* and (f) the anterior *convexity* for two heads of the gluteus maximus, and posteriorly, (g) the *trochanteric* or *digital fossa* for the two obturator, pyriformis, and gemini muscles.

2 :—The INFERIOR EXTREMITY presents anteriorly (a) the *trochlea* for the patella with (b) the *external depression* for the extensor pedis and flexor metatarsi, and posteriorly (c) the *two condyles* (external and internal) for the head of the tibia with (d) the median *Intercondyloid groove* for the tibial spine and crucial interosseous ligaments, (e) the *two external fossæ* (superior for the external lateral ligament and inferior for the popliteus) and (f) the *internal tubercle* for the internal lateral ligament and the adductor magnus and longus.

Tibia.

Has a *shaft* or *body* and 2 *extremities*.

The SHAFT has 3 surfaces and 3 borders.

1 :—The EXTERNAL SURFACE is concavo-convex for the flexor metatarsi and extensor pedis muscles.

2 :—The INTERNAL SURFACE is smooth and subcutaneous and over it runs vena saphena.

3 :—The POSTERIOR SURFACE presents from above downwards, (a) the *triangular surface* for the popliteus, (b) the *longitudinal ridges* for the flexor pedis perforans and accessorius between which (c) the *groove* for the posterior tibial artery, and (d) the nutrient foramen.

1 :—The EXTERNAL BORDER thick and superiorly concave to form the *tibial arch* for the anterior tibial vessels.

2:—The INTERNAL BORDER straight with a *superior tubercle* for the popliteus.

3:—The ANTERIOR BORDER superiorly presents the *tibial crest* or *ridge with the concavity outwards* for the ischio tibialis, sartorius, gracilis and biceps rotator tibialis *internally*, and the triceps abductor femoris and flexor metatarsi *externally*.

1:—The SUPERIOR EXTREMITY:—presents (a) the two articular surfaces (inner ovoid and outer triangular) for the femoral condyles and intervening semilunar cartilages, (b) the central *tibial spine* for the crucial and other ligaments, (c) the *anterior tibial tuberosity* continuous with the tibial ridge for the straight patellar ligaments, (d) the groove for the flexor metatarsi tendon, (e) the *external tibial tuberosity*, with a facet for the fibular head, and (f) the *internal tibial tuberosity*, for the respective lateral ligaments.

2:—The INFERIOR EXTREMITY presents (a) two deep oblique *grooves* with a median ridge for the astragalus, (b) the prominent *inner malleolus*, for the internal lateral ligament, and (c) the wide grooved *outer malleolus* for the peroneus and the external lateral ligament.

Fibula or Peroneus.

Is very rudimentary in the horse and presents a flat *head* for the peroneus with an internal facet for the tibia and a tapering lower end from which extends a fibrous cord to the tibial inferior extremity.

Patella.

Also called the *Rotulla*, *knee-pan* or-cap or *stifle-bone* has (a) the rough *superior surface* for the Triceps cruralis and rectus, (b) the rough convex *anterior surface* for the Tensor fasciæ latæ and Triceps abductor femoris with the *inferior angle* for the middle

straight patellar ligament, (c) the articular *posterior surface* with 2 concavities (inner larger,) for the femoral trochlea, and (d & e) the *external* and *internal borders* for the respective straight patellar ligaments.

Astragalus or Os Tali.

(Ankle bone).

Presents (a) the trochlear *antero-superior surface* for the tibia with an anterior depression for the extensor pedis accessorius, (b) the concave-convex *inferior surface* for the cuneiform magnum with an external facet for the cuboid and a posterior fossa for the great interosseous ligament, (c) the irregular *posterior surface* with 4 facets for the os calcis, (d) the concave *external surface* and (e) the flat *internal surface*, with an inferior tubercle, for the respective lateral ligaments.

Calcaneum or Os Calcis.

Presents a superior *tuberosity* and an inferior *body*.

The *tuberosity* has a convex *external surface*, a concave *internal surface* forming the *tarsal arch* for the flexor pedis perforans tendon, a curved *anterior border*, a straight *posterior border* for the calcaneo-cuboid ligament and a *summit (Point of the hock)* for the gastrocnemii.

The *body* presents 4 anterior facets for the astragalus, 2 inferior facets for the cuboid, a posterior groove for the flexor pedis perforans, & a convex external surface and a concave internal surface for the ligaments.

Cuboid Bone.

Has six surfaces.

The rough *anterior surface* with a depression for the anterior

annular ligament, the rough *posterior surface* for the posterior annular ligament, the rough grooved *external surface* for the ligaments, the *internal surface* with 2 superior and 2 inferior facets for the cuneiform magnum and medium which convert the central groove into the *cuboido-cunean canal* for the perforating pedal blood vessels, the smooth *superior surface* with 2 facets for the astragalus and calcis, and the smooth *inferior surface* with 2 facets and a median ridge for the large and outer small metatarsals.

Cuneiform Magnum (Scaphoid).

Has the concave *superior surface* for the astragalus, the convex *inferior surface* with 3 facets for the cuneiform medium and parvum (posteriorly), the *external border* with 2 facets for the cuboid, and the rough *internal* and *anterior borders* and the grooved *posterior border* for the ligaments.

Cuneiform Medium.

Presents the concave *superior surface* with 2 facets for the cuneiform magnum, the convex *inferior surface* with 2 facets for the large and inner small metatarsals, the convex perforated *anterior border* or *base*, the *external border* with 2 facets for the cuboid, the grooved *internal border* with 1 facet for the cuneiform parvum, and the *posterior apex* projecting superiorly.

Cuneiform Parvum.

Presents the concave *superior surface* for the cuneiform magnum, the *inferior surface* with 2 facets for the large and inner small metatarsals, the *anterior extremity* with a facet for the cuneiform medium, and the rough *posterior extremity (the process)* for the ligaments.

Metatarsus.

The remaining bones of the hind foot almost resemble the corres-

ponding bones of the fore-foot, from which they can be distinguished by certain points of difference.

The LARGE METATARSAL is $\frac{1}{6}$ *longer*, *more convex* anteriorly and *flattened* laterally, and has a supero-external *oblique groove* for the great metatarsal artery, 3 *tarsal facets* with a *median deep fossa*, and the four *splint* facets placed more posteriorly than in the large metacarpal, which has 4 *Carpal* facets (due to the external being divided into two by a groove).

The SMALL METATARSALS are longer with bigger heads than the small metacarpals and the *external metatarsal* has 2 tarsal facets for the cuboid and the *internal metatarsal* has 3 tarsal facets, 2 for the cuneiform parvum and 1 for the medium. The *external metacarpal* has 1 carpal facet for the unciform and the *internal metacarpal* has 2 carpal facets for the trapezoid and magnum.

The HIND OS SUFFRAGINIS is longer than the *fore*, with a larger superior, and a smaller inferior, extremity. The HIND OS CORONA is longer but less broad than the *fore*.

The HIND NAVICULAR is shorter and narrower than the fore.

The HIND OS PEDIS is more pointed anteriorly, more concave at its inferior surface, and less spread out at its inferior border than the fore os pedis which has also a central depression on the posterior crescentic margin.

A few carpal bones resemble one another and a few tarsal ones in shape, but they can be distinguished from one another by the following points:——

The UNCIFORM can by its posterior *rounded apex* (unciform process) be distinguished from the *trapezoid and carpal cuneiform* which has a triangular superior *cup-shaped* surface.

The OS MAGNUM can by its *flat inferior surface* and *broad* posterior *blunt apex* be distinguished from the tarsal cuneiform

magnum and medium, and the *cuneiform* medium can be distinguished from the *Magnum* by its *smaller size* and *posterior apex projecting superiorly.*

The CUBOID can be distinguished from the carpal scaphoid by its *smaller size* and by the greater number of its articular facets.

Several bones of the skull and those of the chest and limbs exist in pairs, and can be distinguished as regards the sides to which they belong by certain points which are as follow:—

Parietal.—Concave surface above and bevelled border facing, the prominence of os triquetrum points to the side.

Frontal :—Cerebral concave surface having a deep groove forwards and upwards, the external orbital process points to the side.

Squamosal :—Glenoid cavity on the zygomatic process forwards and downwards, the serrated free extremity of the process points to the side.

Petrosal :—External auditory meatus downwards and forwards the styloid process points to the side.

Nasal :—Convex surface forwards and the apex downwards, the long straight dentated border points to the side.

Superior Maxilla :—External surface with the infra-orbital foramen forwards and alveoli for molar teeth upwards, the maxillary spine points to the side.

Premaxilla :—Interdental space forwards and downwards, and the alveoli for the incisors point to the side.

Malar :—Zygomatic ridge backwards and downwards, and the zygomatic process points to the side.

Lachrymal :—Orifice of the lachrymal duct forwards and upwards, the lachrymal tubercle points to the side.

Ribs :—Convex external surface forwards, and the grooved posterior border with the tubercle upwards, the head points to the side.

Scapula :—Spine facing and the larger postea-spinatus fossa below, the glenoid cavity points to the side.

Humerus :—Deep condyloid or olecranon fossa forwards and downwards, the external surface with the musculospiral groove points to the side.

Radius :—Convex anterior surface forwards, and the larger superior extremity upwards, the larger glenoid cavity on the superior articular surface points to the side.

Ulna :—Sigmoid (crescent-shaped) notch upwards and forwards, the concave surface of the olecranon process points to the side.

Scaphoid :—Shallow broad concavity on the superior articular surface upwards and backwards, the non-articular rough convex external surface which is continuous with the anterior surface points to the side.

Lunare :—Triangular articular surface upwards, and the base forwards, the surface with 3 facets points to the side.

Cuneiform :—Triangular cup-shaped facet upwards with its prominent apex forwards, the surface with 2 facets points to the side.

Trapezium:—Concave articular facet forwards and upwards, the concave surface points to the side.

Trapezoid:—Smooth rounded articular surface upwards, and the very small facet for the pisiform (or a small prominent tubercle) posteriorly, the rough convex non-articular surface without facets points to side.

Os Magnum:—Concavo-convex surface above, and the base facing, the deeply notched surface with 3 facets points to the side.

Unciform:—Convex articular surface upward, and the apex (unciform process) backwards, the broad articular surface with two facets points to the side.

Large Metacarpal:—Anterior Convex surface forwards, the extremity with 2 condyles and a median ridge downwards, the larger condyle points to the side.

Inner small metacarpal:—Two facets on the head for the cannon bone upwards and forwards, the larger horizontal facet points to the side.

Outer small metacarpal:—Two facets on the head for the cannon bone upwards and forwards, the facet which is continuous with one for the unciform above points to the side.

Os *Suffraginis:*—Convex surface facing and the larger concave extremity above, the larger glenoid cavity points to the side.

Os Corona:—Very rough convex surface farwards, and the concave extremity upwards, the larger glenoid cavity points to the side.

Os Pedis:—Wings backwards and the concave articular surface upwards, the larger glenoid cavity points to the side.

Os Naviculare:—Triangular articular surface for the os pedis forwards and upwards, the larger cancavity on the smooth articular surface for the os corona points to the side.

Os Innominatum:—Ilium above and the supracotyloid eminence (the superior ischiatic spine) facing, the cotyloid cavity points to the side.

Femur:—Condyles downwards and backwards, the head points to the side.

Tibia:—Tibial ridge upwards and backwards, the larger tibial tuberosity with the facet for the fibula points to the side.

Fibula:—Tapering point downwards and the cancave border forwards,the smooth articular surface for the tibia points to the side.

Patella :—Smooth articular surface forwards and downwards, and its smaller concavity points to the side.

Astragalus :—Trochlea forwards and upwards, and the concavo-convex surface for the cuneiform magnum downwards, the lateral surface with a prominent tubercle points to the side.

Os *Calcis* :—The surface with 4 facets for the astragalus antero-inferiorly, and the tuberosity superiorly, the grooved surface of the tuberosity points to the side.

Cuboid :—Broad smooth articular surface having three continuous facets forwards and downwards, the grooved surface with 4 facets points to the side.

Cuneiform Magnum :—Concave articular surface above with the larger facet anteriorly, the non-articular lateral border which is continuous with the facing one points to the side.

Cuneiform medium :—Concave articular surface upwards, and the apex backwards, the deeply notched lateral border points to the side.

Cuneiform Parvum :—Large concave articular facet upwards, and forwards, the convex lateral surface points to the side.

Large metatarsal :—Convex surface backwards and the extremity with 2 condyles and a median ridge downwards, the groove at the upper extremity for the great metatarsal artery points to the side.

In the following table the muscles and bones to which they are attached have been enumerated :—

Atlas.

Body :-

1.—Longus colli.
2.—Rectus capitis anticus minor.
3.—Rectus capitis anticus lateralis.
4.—Obliquus capitis posticus.
5.—Rectus capitis posticus minor.

Wings or Transverse processes:—

6.—Levator Humeri.
7.—Splenius.
8.—Trachelo-mastoideus.
9.—Obliquus capitis anticus.
(4) :—Obliquus capitis posticus.

Dentata.

Body :—

1.—Longus Colli.

Tranverse proresses :—

2.—Levator humeri.
3.—Intertransversalis colli.

Superior spine :—

4.—Obliquus capitis posticus.
5.—Complexus minor.
6.—Rectus capitis posticus major.
7.—Spinalis colli.

3rd to 7th Cervical Vertebræ.

Body :—

1.—Longus colli.

Transverse processes :—

2.—Rectus capitis anticus major (3rd to 5th.)
3.—Intertransversalis colli.
4.—Transversalis costarum (7th).
5.—Levator humeri (3rd and 4th).
6.—Splenius (3rd to 5th).
7.—Serratus magnus.
8.—Longissimus dorsi (4th to 7th).

Superior Spine :—

(8).—Longissimus dorsi (4th to 7th).
9.—Spinalis colli.

Oblique (articular) processes :—

(3).—Intertransversalis colli.
(9).—Spinalis colli.
10.—Trachelo—mastoideus.
11.—Complexus major.

Dorsal Vertebræ.

Body :—

1.—Longus Colli (first 6).
2.—Psoas parvus (last 3).
3.—Psoas magnus (last 2).

Transvese processes :—

4.—Complexus major (first 6).
5.—Trachelo-mastoideus (first 2).
6.—Longissimus dorsi.
7.—Semispinalis dorsi.
8.—Levatores costarum.

Superior spine :—

9.—Splenius (first 6).
(4).—Complexus major(first6).
(5).—Trachelo-mastoideus (first 2).
(6).—Longissimus dorsi.
(7.)—Semispinalis dorsi.
10.—Trapezius dorsalis (3rd to 11th).
11.—Latissimus dorsi(last15).
12.—Superficialis costarum (last 17).
13.—Rhomboideus brevis (2nd to 7th).

Lumbar Vertebræ.

Body:—

1.—Psoas magnus.
2.—Psoas parvus.
3.—Crura diaphragmatica (right from first 5,left from first 2).

Transverse processes:—

(1).—Psoas magnus.
4.—Longissiums dorsi.
5—Quadratus lumborum.
6.—Intertransversalis lumborum.
7.—Tansversalis abdominis.

Superior spine.

(4):—Longissmus dors
8—Latissimus dorsi.
9.—Superficialis costarum (first 3).
10.—Semispinalis lumborum.

Oblique (articular) processes:—

(4):—Longissimus dorsi.
(10):—Semispinalis lumborum.

Sacrum.

Supersacral spine:—

1.—Longissimus dorsi.
2.—Gluteus externus.
3.—Triceps abductor femoris.
4.—Biceps rotator tibialis.
5.—Erector coccygis.

Side :—

(1).—Longissimus dorsi.
6.—Semispinalis lumborum.
7.—Gluteus maximus.
8.—Pyriformis.
9.—Curvator coccygis.
10.—Compressor coccygis.

Inferior Surface :—

11.—Depressor coccygis.

Coccyx.

1.—Erector coccygis (superior surface).
2.—Depressor coccygis (inferior surface).
3.—Curvator coccygis-(sides).

4.—Compressor coccygis (first 2, sides).

Occipital.

Occipital crest :—

1.—Levator humeri.
2.—Splenius.
3.—Complexus major.
4.—Complexus minor.
5.—Temporalis.

Mastoid ridge :—

6.—Obliquus capitis anticus.
7.—Trachelo-mastoideus.
(1).—Levator humeri.
(2).—Splenius.

Cervical tuberosity :—

(3).—Complexus major.
(4).—Complexus minor.
8.—Rectus capitis posticus Major.
9.—Rectus capitis posticus minor.

Styloid processes :—

(6).—Obliquus capitis anticus.
10.—Stylo-hyoideus.
11.—Stylo-maxillaris.
12.—Digastricus.
13.—Rectus capitis lateralis.

Basilar process :—

14 and 15.—Rectus capitis anticus major and minor.

Parietal.

1.—Temporalis (external surface and ridge).
2 and 3.—Attolens maximus and posticus (parietal ridge).

Frontal.

External surface:—

1.—Levator labii superioris alæque nasi.
2—Temporalis.

Temporal.

Squamosal:—

Anterior mastoid process:—

1.—Trachelo-mastoideus.
2.—Splenius.
3.—Levator humeri.

External surface and zygoma:—

4.—Temporalis.

Petrosal:—

Styloid process:—

5.—Levator palati.
6:—Tensor palati.

External auditory meatus:—

7.—Mastoido-auricularis.

Sphenoid.

Body (external surface) :—

1 and 2.—Rectus capitis anticus major and minor.

Pterygoid process :—

3.—Pterygoideus internus.
4.—Pterygoideus externus (also from *ala*).

Superior Maxilla.

Maxillary spine :—

1.—Panniculus carnosus.

2.—Masseter.
3.—Dilatator naris lateralis.

Ex'ernal surface :—
(2).—Masseter.
4.—Nasalis longus.

Alveolar tuberosity :—
5.—Depressor Labii inferioris.
6.—Buccinator (also from molar alveoli).

Premaxilla.

External surface :—
1.—Dilatator naris inferioris.
2.—Depressor labii-superioris.

Nasal.

External surface :—
1.—Dilatator naris superioris.
2.—Levator labii superioris alæque nasi.
3.—Dilatator naris transversalis (also from nasal peak).

Lachrymal.

Lachrymal tubercle:—
1.—Lachrymalis (also external surface).
2.—Orbicularis palpebrarum.

Malar.

External surface :—
1.—Nasalis longus.

Palatine.

Palatine ridge :—
1.—Pterygoideus internus.

Inferior Maxill-

External surface :—
1.—Masseter.
2.—Buccinator.
3.—Levator labii inferioris (inferior interdental space)

Internal surface :—
4.—Pterygoideus externus.
5.—Mylo-hyoideus (mylo-hyoid ridge).
6.—Genio-hyoideus (genial tubercle)
7.—Digastricus (also inferior border).

Angle :—
(1).—Masseter.
8.—Pterygoideus internus.
9.—Sterno-Maxillaris..
10.—Stylo-Maxillaris.

Superior border :—
11.—Depressor labii inferioris.

Coronoid process :—
12.—Temporalis.

Os Hyoides.

Body :—
1.—Mylo-hyoideus.
2.—Hyoideus parvus.
3.—Hyo-epiglottideus.
4.—Hyo-glossus brevis.
5.—Hyo-glossus parvus.
6.—Genio-hyo-glossus.
7.—Lingualis.

Spur process :—
8.—Sterno thyro-hyoideus.

9.—Subscapulo-hyoideus.
10.—Genio-hyoideus.
(1).—Mylo-hyoideus.
(4).—Hyo-glossus brevis.

Heel process :—
(2).—Hyoideus parvus.
11.—Hyoideus magnus.
12.—Hyo-pharyngeus.
13.—Hyo-thyroideus.

Cornu:—
(2).—Hyoideus parvus.
(4).—Hyo-glossus brevis.
(11).—Hyoideus magnus.
14.—Stylo-hyoideus.
15.—Kerato-pharyngeus.
16.—Hyo-glossus longus.

Corniculum :—
(2).—Hyoideus parvus.
(5).—Hyo-glossus parvus.
17.—Hyoideus transversus.

Scapula.

External surface :—
1.—Antea-spinatus.
2.—Postea-spinatus.

Spine :—
3.—Trapezius cervicalis. } (tubercle.)
4.—Trapezius dorsalis. } (tubercle.)
5.—Teres externus. } (tubercle.)
6.—Levator humeri. (Scapular fascia).

Internal surface :—
7.—Subscapularis.
8.—Serratus magnus.

Cartilage of prolongation :—
9.—Rhomboideus longus.
10.—Rhomboideus brevis.
(2).—Postea-spinatus.

Posterior border and angle :—
11.—Postea-spinatus minor.
12.—Scapulo-ulnaris.
13.—Caput magnum.
14.—Teres internus.
(2).—Postea-spinatus.
(5).—Teres externus.

Anterior border and angle :—
15.—Pectoralis parvus.
(1).—Antea-spinatus.
(9).—Rhomboideus longus.

Superior border :—
(10).—Rhomboideus brevis.

Neck (inferior angle) :—
16.—Scapulo-humeralis posticus.

Coracoid process :—
17.—coraco-humeralis.
18.—Flexor brachii.

Humerus.

Superior extremity :—
1.—Antea-spinatus (trochanters. S.)
2.—Postea-spinatus (c, e.t.)
3.—Subscapularis (i.t.)
4.—Pectoralis magnus (both e and i. t.)
5.—Panniculus carnosus (i.t.)

Shaft :—

Below the head.
- 6.—Scapulo-humeralis posticus.
- 7.—Humeralis obliquus.
- 8.—Caput medium.

Deltoid ridge.
- 9.—Postea-spinatus minor.
- 10.—Teres externus (e.t.)
- 11.—Pectoralis anticus.
- 12.—Levator humeri.

13.—Teres internus (i.t.)
14.—Latissimus dorsi (i. t.)
15.—Coraco-humeralis (ant.)
16.—Caput parvum (post.)

Inferior extremity :—

Epitrochlea.
- 17.—Anconeus.
- 18.—Extensor metacarpi magnus.
- 19.—Extensor pedis.
- 20.—Flexor metacarpi externus.

Epicondyle.
- 21 and 22.—Flexor metacarpi medius and internus.
- 23 and 24.—Flexor pedis perforatus and perforans.

Radius.

Superior extremity :—

E.T. Bicipital T.
- 1.—Flexor brachii.
- 2.—Humeralis obliquus.
- 3.—Extensor pedis.
- 4.—Extensor suffraginis.

Shaft :—

5.—Extensor metacarpi obliquus.
6.—Radialis accessorius.
(4).—Extensor suffraginis.

Inferior extremity :—

7.—Extensor metacarpi magnus (mid. groove.)
(3).—Extensor pedis (ext. groove.)
(4).—Extensor suffraginis.
(5).—Extensor metacarpi obliquus (oblique or int. groove).

Ulna.

Olecranon process :—

1.—Triceps extensor brachii.
2.—Scapulo-ulnaris.
3.—Anconeus.
4.—Flexor metacarpi medius.
5.—Ulnaris accessorius.

Shaft :—

(5).—Ulnaris accessorius (post.)
6.—Humeralis obliquus (int.)
7.—Extensor suffraginis.

Trapezium.

1 and 2.—Flexor metacarpi externus and medius.

Large Metacarpus.

1.—Extensor metacarpi magnus (antero-int tuberosity of the S. E).

Outer Splint.

1.—Flexor metacarpi externus (head).

Inner Splint.

Head :—

1.—Extensor metacarpi obliquus.

2.—Flexor metacarpi internus.

Os Suffraginis.

1.—Extensor suffraginis (S. E).

2.—Extensor pedis (shaft).

Os coronæ.

1.—Extensor pedis (ant. surf.)

2.—Flexor pedis perforatus (lateral surfaces).

Os pedis.

Pyramidal process :—

1.—Extensor pedis.

Semilunar ridge :—

2.—Flexor pedis perforans.

Os Innominatum.

Ilium.

External surface (Dorsum): —

1.—Gluteus maximus.

2.—Gluteus internus.

3.—Rectus femoris (outer head).

4.—Rectus parvus.

Internal surface (Venter) :—

5.—Iliacus.

(3).—Rectus femoris (inner head).

6.—Psoas parvus (ilio pectineal eminence).

7.—Pyriformis

Iliac crest :—

8.—Longissimus dorsi.

9.—Obliquus abdominis externus.

(1).—Gluteus Maximus.

Anterior iliac spine :—

(1).—Gluteus Maximus.

(5).—Iliacus.

(8).—Longissimus dorsi.

(9).—Obliquus abdominis externus.

10.—Obliquus abdominis internus.

11.—Transversalis abdominis.

12.—Quadratus lumborum.

13.—Sartorius.

14.—Gluteus externus.

15.—Tensor fasciæ latæ.

Superior ischiatic spine :—

16.—Compressor coccygis.

(2).—Gluteus internus.

Ischium.

Inferior surface :—

17.—Obturator externus.

18.—Obturator internus.

19.—Gemelli.

20.—Adductor magnus.

21.—Gracilis.

22.—Ischio femoralis.

Ischial tuberosity :—

(20).—Adductor magnus.

23.—Triceps abductor femoris.
24.—Biceps rotator tibialis.
25.—Erector penis.

Pubis.

Inferior surface:—

(13).—Sartorius.
(17).—Obturator externus.
(21).—Gracilis.
26.—Adductor brevis.
27.—Adductor longus.

Anterior border (Crest) :—

(By prepubian tendon.)
- (9).—Obliquus abdominis externus.
- (10).—Obliquus abdominis internus.
- (11).—Transversalis abdominis.
- 28.—Rectus abdominis.

29.—Pectineus (Pectineal tubercle).

Femur.

Superior extremity :—

(T. Major).
1.—Gluteus internus.
2.—Gluteus maximus.

(T. fossæ).
3.—Obturator externus.
4.—Obturator internus.
5.—Pyriformis.
6.—Gemelli.

Shaft :—

(Ant. Surf.)
7.—Vastus externus.
8.—Rectus parvus.
9.—Crureus.

(Posterior Surface)
10.—Ischio-femoralis.
11.—Adductor brevis.
12.—Adductor longus.
13.—Triceps abductor femoris.
14.—Gastrocnemius externus (also from supracondyloid crest)

(T. Minor ext.)
15.—Gluteus externus.
16.—Tensor fasciæ latæ.
(7).—Vastus externus.

(T. Minor int.)
17.—Psoas Magnus.
18.—Iliacus.
19.—Vastus internus.
20.—Pectineus (a little below).
21.—Gastrocnemius internus (supracondyloid fossa).

Inferior extremity :—

(i. c.)
(12).—Adductor longus.
(14).—Gastrocnemius externus.
22.—Adductor magnus.

(e. c.)
23.—Extensor pedis.
24.—Flexor metatarsi (Superfial portion).
25.—Popliteus.

Patella.

Superior Surface :—

1.—Quadriceps cruralis.

Anterior Surface :—

2.—Tensor fasciæ latæ.

3.—Triceps abductor femoris.

Tibia.

Tibial Ridge :—

1.—Adductor magnus.

2.—Sartorius.

3.—Gracilis.

4.—Biceps rotator Tibialis.

5.—Triceps abductor femoris.

6.—Flexor metatarsi.

External Surface :—

(6).—Flexor metatarsi (Deep portion).

7.—Extensor pedis.

Posterior surface :—

8.—Popliteus.

9.—Flexor pedis perforans.

10.—Flexor pedis accessorius.

External malleolus :—

11.—Peroneus.

Supero-external tuberosity :—

12.—Plantaris.

Fibula.

External Surface :—

1.—Peroneus.

2.—Flexor pedis perforans.

Astragalus.

1.—Extensor pedis brevis.

Os Calcis.

Tuberosity :—

1.—Gastrocnemius externus.

2.—Gastrocnemius internus.

3.—Flexor pedis perforans. (int. surf.)

Cuboid.

1.—Flexor metatarsi (superficial portion).

Cuneiform parvum.

1.—Flexor metatarsi (deep portion).

Large Metatarsal.

Head :—

1.—Flexor metatarsi (both portions).

Digit.

Os Suffraginis.

1.—Extensor pedis (shaft).

Os Coronæ.

1.—Extensor pedis (ant. surf.)

2.—Flexor perforatus or Gastrocnemius internus (lateral surfaces).

Os pedis.

1.—Extensor pedis (pyramidal process).

2.—Flexor pedis perforans (semilunar ridge).

Arthrology.

The union of two or more bones of the skeleton by means of certain soft structures is termed the *Joint* or *Articulation*, the study of which is called *Arthrology* or *Syndesmology*.

The structures which enter into the formation of a joint are bone, cartilage, fibro-cartilage, ligaments, synovial membrane and adipose tissue.

The long bones articulate by their expanded extremities which consist chiefly of spongy cancellous tissue with a thin crust of compact substance; the flat bones articulate usually by their edges; and the short bones, by various parts of their surface. The layer of compact osseus tissue which forms the articular surface, and to which the cartilage is attached, is called the *Articular Lamella* which is of a white colour, extremely dense and differs from ordinary compact osseous tissue in having much larger Lacunæ but no Haversian canals, nor canaliculi.

Cartilage or Gristle :—

It is a non-vascular firm elastic bluish or yellowish white animal substance found chiefly in the joints, in the walls of the thorax and in various patent tubes as the air passages, nostrils and ears. Cartilage is broadly divided into two kinds, (a) *Temporary* that which is converted into bone, and (b) *Permanent*.—that which remains unossified throughout the life of the animal. It is also divided into *Articular*—that which encrusts the articular surface of bones in joints and is not invested by the perichondrium,—and *Non-articular* variety. Physiologists classify permanent cartilage into 3 forms according to its minute Anatomy viz. (1) *True* or *hyaline* cartilage, (2) *Fibrous* cartilage and (3) *Cellular* cartilage.

Structure of Cartilage.

All kinds of cartilage are composed of oval, round or fusiform (a) Cells or Corpuscles containing a *nucleus* and *a nucleolus* and usually imbedded in (b) an intercellular substance called the Matrix which yields 'chondrin' on boiling, a substace varying slighty from gelatine of bone. All cartilages except the articular variety are invested by a thin tough fibrous membrane—the *Perichondrium* which is supplied with blood vessels, lymphatics and nerves and is of essential importance for the life and growth of the cartilage. Cartilage itself is non-vascular and not supplied with nerves but derives its nutrition from the vessels of the perichondrium and of the bones.

1 :—*True* or *hy aline cartilage* :—consists of irregularly shaped nucleolo-nucleated cells grouped in patches of various shapes and sizes and placed at unequal distances, and of homogeneous or dimly granular matrix.

2 :—*Fibrous Cartilage* :—Is of 2 kinds viz. white fibro cartilage and yellow elastic fibro cartilage. In both the cells are round or oval and nucleolo-nucleated, but the matrix, in the former, resembles white fibrous tissue, and in the latter, fine yellow elastic tissue.

3 :—*Cellular* or *Reticular cartilage:*—Is composed almost entirely of cells with little or no matrix, and the walls of cells come in contact and present a net-like appearance, hence it is termed *Reticular*.

Table of classification of cartilage.

Cartilage.

- **Temporary.**
- **Permanent.**
  - **Hyaline.**
    - *Articular* or *Encrusting.*—Forming a layer over the articular surfaces.
    - *Costal.*—Acting as elastic prolongations to the ribs connecting them with the sternum.
    - *Membraniform.*—Thin plates forming permanently open tubes as the trachea.
  - **Fibrous.**
    - **White Fibrocartilage.**
      - *Inter-Articular.*—A pad of cartilage-*Meniscus*-interposed between the two articular cartilages.
      - *Circumferential.*—Deepening an articular cavity as the acetabulum.
      - *Connecting.*—Interposed between bones e. g. the intervertebral discs.
      - *Investing or Sheatiform.*—Covering the parts of bones over which the tendons glide.
    - Yellow Elastic fibro-cartilage.—Found in the epiglottis, ears and Eustachian tubes.
  - **Cellular.**—Found in the ear of small rodents as the rat.

Ligaments.

Ligaments are connecting bands of fibrous tissue, principally of *white fibrous*, but sometimes of *yellow elastic* tissue as the ligamentum nuchæ and ligamenta subflava.

There are 2 kinds of white ligaments:—

(a) *Capsular*, *Bursal* or *Membraniform* ligaments which are membranous sacs enveloping true joints, and (b) *Funicular* or *Bind-*

ing ligaments which are ribbon-shaped cords passing from one bone to another and connecting them. With them are included the Interosseous, which are placed *between* bones, and Annular or ring-like ligaments, which find down and protect the tendons about the joints and convert grooves in the bones into canals for their gliding.

Synovial Membranes are thin membranes of the shape of a short wide tube, attached by their open ends to the circumference of the articular surfaces and line the internal surface of the various ligaments, especially the capsular, of joints. They, in structure, resemble the serous membranes but differ in the nature of their secretion—the *synovia* or *joint oil*—which is a viscid glairy fluid, like the white of egg, and alkaline in reaction.

There are 3 kinds of synovial membranes.

1 :—The *Articular or Capsular*, which line the capsular ligaments of all true joints ; (2) The *Bursal*, which are interposed between structures moving upon each other and are of two sub-varieties, viz, *Synovial Bursæ* interposed between muscles or tendons and projecting bony surfaces, and *Bursæ Mucosæ* situated in the subcutaneous tissue between the skin and the prominent bony parts, e.g. the olecranon, the patella and the malleoli. (3) The Vaginal, (Synovial sheaths) which form sheaths for the easy gliding of tendons in bony or tendinous canals.

Motion in joints.

Is of 4 kinds :—

1 :—*Gliding*, in which one articular surface glides over another

2 :—*Angular*, having 4 sub-divisions, viz, (a) *Flexion*, in which 2 or more bones are brought forwards at an acute angle, (b) *Extension*, in which 2 or more bones are carried backwards into a straight line, (c) *Abduction*, in which a bone or limb is taken outwards from the central plane of the body, and (d) *Adduction*, in which it is drawn inwards towards the central plane.

3:—*Circumduction*, by which the distal end of a bone or limb forms or draws the arc of a circle and 4 :—*Rotation*, which means a partial circular motion of bones on their own axes.

A TABULAR VIEW OF THE NAMES, CHARACTERS AND EXAMPLES OF THE DIFFERENT KINDS OF ARTICULATIONS.

Synarthrosis, or Immovable joint.

Articular surfaces separated by fibrous or cartilaginous material, without any sinovial cavity and proper ligaments and immovably connected with each other.

- SUTURA. Articulation by processes and indentations interlocked together with an intervening layer of fibrous tissue.
  - *Sutura Vera* (true) articulate by indented margins.
    - *Dentata*, having large and tooth like processes, e. g., the interparietal.
    - *Serrata*, having small and fine processes like the teeth of a saw, e. g., the interfrontal.
    - *Limbosa*, having bevelled margins and dentated processes, e. g., the parieto-occipital.
  - *Sutura Notha* (false) articulate by rough surfaces.
    - *Squamosa*, having thin bevelled margins overlapping each other, e.g., the parieto-squamosal.
    - *Harmonia*, formed by the approximation of contiguous rough surfaces without any marked irregularity, e. g., inter nasal.
- SYNCHONDROSIS. Articulation resembles a suture but the intervening material is cartilaginous and not simply fibrous, e.g., between the basi-occipital and basi-sphenoid.
- SCHINDYLESIS. Formed by the lodgment of a thin plate of one bone into a slit of another, e.g, the orbito-sephenoid into the incisura sphenoidalis of the frontal.
- GOMPHOSIS. Formed by the insertion of a conical process into a cavity or socket, e.g., the teeth.

(Continued) :—

Diarthrosis or Movable joint.

Articular surfaces covered with encrusting cartilage, and connected by ligaments allowing distinct motion, and lined by synovial membranes.

ARTHRODIA, PLANIFORM DIARTHROSIS or GLIDING joint. Flat or undulated bony surfaces glide upon each other, e. g., the carpal.

ENARTHROSIS or BALL-and-SOCKET joint. A globular head received into a cup like cavity, e. g., the hip and shoulder.

GINGLYMUS, TROCHLEAN or PERFECT HINGE joint. Articular surfaces so fitted together as to limit the motion to one plane, backwards and forwards, e. g., the elbow.

CONDYLOID, COMPOUND GINGLYMUS or IMPERFECT HINGE joint. In it beside extension and flexion there is rotation, e. g., the stifle.

DIARTHROSIS ROTATORIUS, GINGLYMUS LATERALIS, PIVOT, TROCHOID, or ROTATORY joint. A pivot-like process of one bone turns within a ring of another, e. g., the atlo-axoid.

Amphiarthrosis or Mixed joint.

SYMPHYSIS :—

In it the contiguous articular surfaces are joined together by ligaments and by a pad or disc of fibro-cartilage adherent to the ligaments of the joint and allowing very limited motion, and the synovial membrane is absent, e. g., between the vertebral bodies and the pelvic symplysis.

A. S.=Articular surfaces. M. of U.=Mode of union. S. M. Synovial membrane. Mts.=Movements.

Common Vertebral Articulations.

(Amphiarthroses).

A. S :—The bodies and articular (oblique) processes of all *true vertebræ* except the Atlas and axis.

M. of U :—The *intervertebral discs* placed between the bodies and the *common* and *special* ligaments.

The *Common ligaments* are 3 viz :—

(a) The *Superior Common Vertebral* extending in the spinal canal from the axis to the sacrum on the superior part of the *bodies.*

(b) The *Inferior Common Vertebral* extending from the 6th dorsal to the sacrum below the *bodies.* (It is replaced by the longus colli muscle anterior to the 6th dorsal).

(c) The *Supraspinous Common Vertebral* is called the *superdorso lumbar ligament* in the dorsal and lumbar regions, where it is a white fibrous cord and extends from the superior spine of the 1st dorsal to that of the sacrum, and the *Ligamentum Nuchæ* or *Ligamentum Colli* in the cervical region, where it consists of a *funicular* and a *lamellar* portion, both formed of yellow elastic tissue. The former is double—right and left—between which the latter is vertically placed, and both extend from the spines of the 1st, 2nd, and 3rd dorsal vertebræ to the cervical (occipital) tuberosity, and the spines of the six posterior cervical vertebræ (by separate digitations), respectively.

The *Special ligaments* are 4 viz :—

(a) The *Interspinous* connecting the superior spines.

(b) The *Interlamellar* (Ligamenta Subflava) connecting the laminæ of the *arches.*

(c) The *Intertransverse* connecting the transverse processes.

(d) The *Capsular* enclosing the articulations of the oblique processes.

The transverse processes of the two last lumbar vertebræ articulate on each side by a true arthrodial joint, present only in Solipeds.

Special Vertebral Articulations.

1.—Sacro-lumbar articulation :—

A. S. :—The bodies and oblique processes of the last lumbar and those of the first sacral, and concave facets on the posterior border of the transverse processes of the last lumbar and convex facets on the sides of the base of the sacrum.

M. of U.—The usual vertebral ligaments and a pair of *Capsular* ligaments for the transverse joints.

2 & 3.—Sacro-Coccygeal and Intercoccygeal articulations:—The articular surfaces are enveloped by *capsular* ligaments with intervening intervertebral *biconcave* discs.

Movements of the spine in general :—*Flexion* (arching upwards) *Extension* (arching downwards) and *rotation*. Also *lateral motion* and *circumduction* in the cervical and coccygeal regions.

4.—Occipito-atloid articulation (Diarthrosis condyloid). :—

A. S. :—The two occipital condyles and the glenoid cavities of the Atlas.

M. of U. :—5 ligaments.

(a) The *Capsular* completely envelopes the joint.

(b and c) The *two Styloid* or *Lateral* extend, on each side, from the base of the occipital styloid processes to the sides of the Atlas.

(d and e) The *Superior* and *Inferior Occipito Atloid* (Superior and Inferior Suspensory) extend respectively, from the superior and inferior margins of the Foramen Magnum to the superior and inferior notches on the anterior part of the atlas.

S. M :—Two, one for each condyle.

Mts :—*Extension*, by Rectus capitis posticus major and minor, Complexus major and minor, Trachelo mastoideus and obliquus capitis anticus ; *flexion* by Rectus capitis lateralis and anticus major and minor ; *latera lmotion* and *circumduction* by. Rectus capitis lateralis and anticus major, Complexus major, Trachelo mastoideus and Obiiquus capitis anticus.

5.—**Atloid-Axoid Articulation** (Diarthrosis rotatorius) :—

A. S :—The odontoid process of the axis with its lateral facets and the concave posterior surface on the floor of the ring of the atlas with its lateral facets.

M. of U. :—5 ligaments.

(a) The *Short Odontoid* extends from the superior part of the odontoid process to the rough surfaces, on either side, within the Atloid ring.

(b) The *Long Odontoid* (occipito-axoid) extends from the odontoid process to either side within the foramen magnum.

(c and d) The *Superior* and *Inferior Atlo-axoid* extend between the superior and inferior spines of the atlas and those of the axis.

(e) The *Capsular* extends between the superior and inferior atlo-axoid ligaments from the atlas to the axis and superiorly closes the *atlo-axoid space.*

S. M :—Single.

Mts :—*Rotation* by the obliquus capitis posticus muscles. The atlas with the head rotates on the odontoid pivot of the axis which remains fixed.

Skull Articulations.

They are all synarthrodial joints except the occipito-atloid, the temporo-maxillary and the hyoid articulations, and are called the *Sutures* of the skull, which are as follow :—

1 :—The LONGITUDINAL SUTURE extends from the nasal peak

to the occipital crest and includes the *nasal* suture between the nasal bones, the *Frontal* suture between the frontal bones, and the *Sagittal* or *Interparietal* suture between the parietal bones.

2 :—The TRANSVERSE SUTURE joins the nasal and lachrymal bones to the frontal.

3 :—The CORONAL SUTURE is between the frontal and parietal bones.

4 :—The SUTURA LIMBOSA is between the parietal and occipital bones.

Temporo-Maxillary Articulation.

(Arthrodial Ginglymus).

A. S. :—The condyle of the inferior maxilla and the glenoid cavity and condyle of the squamosal bone.

M. of U :—3 ligaments and a meniscus.

(a) The *Capsular* attached to the circumferences of the articular surfaces and the meniscus.

(b) The *Posterior* extends from the anterior mastoid process to the inferior maxillary neck.

(c) The *External Lateral* extends from the squamosal zygoma to the inferior maxillary neck.

The *Meniscus* (fibro-cartilaginous disc) is concavo-convex above and concave below, and placed between the articular surfaces.

S. M. :—Two, separated by the meniscus.

Mts. :—*Flexion* or *elevation* of the inferior maxilla by the masseter, temporalis & pterygoideus internus and externus; *Extension* or *depression* by the stylo-maxillaris and digastricus ; *Lateral motion* by the temporalis and pterygoidei acting singly on one side and *Horizontal gliding* including *protraction* by the pterygoideus externus and *retraction* by the Stylo-maxillaris and digastricus.

Hyoid articulations.

1 :—The *Temporo-hyoid joint* is an amphiarthrosis, formed by

the petrosal hyoid process and superior angle of the hyoid cornu with an intervening elastic fibro-cartilage.

2 :—The *Proximal Interhyoid joint* is an amphiarthrosis formed by the hyoid cornu & corniculum joined together by a thick fibro-cartilage, within which is often present a bony nucleus, which in ruminants becomes the *second corniculum.*

3 :—The *Distal Interhyoid joint* is a true arthrodia, formed by the corniculum cavity and the rounded lateral facet on the hyoid body, united together by a *capsular* ligament lined by a small synovial membrane.

Thoracic Articulations.

1.—*Costo-Vertebral Articulations* include those between rib heads and vertebral bodies, and between rib neck and tubercle and vertebral transverse processes.

A.—Articulations between rib-heads and vertebral bodies :—

A. S.—The rib head and facet formed by the bodies of two dorsal vertebræ.

M. of U.—3 ligaments.

(a) The *Inferior costo-vertebral* or *stellate* extends from the the inferior part of the rib head to the anterior and posterior vertebræ and to the intervertebral disc by 3 bands.

(b) The *Capsular* envelopes the joint.

(c) The *Interarticular* or *Round* attached to the rib head and intervertebral disc within the joint.

S. M.—Two—anterior and posterior—separated by the interarticular ligament.

Mts.—*Elevation, depression,* and a slight motion forwards and backwards. (More in the mare than in the horse).

B.—Articulations between the rib tubercles and vertebral transverse processes.

A. S.—The rib tubercles and facets on the transverse processes of the posterior vertebræ.

M. of U:—3 ligaments.

(a) The *Anterior costo-transverse* (Interosseous) unites the rib-neck with the vertebral transverse process.

(b) The *Posterior costo-transverse* extends from the rib tubercle to the summit of the transverse process.

(c) The *Capsular* envelopes the joint.

S. M.—Single.

Mts.—Slight gliding motion.

2. *Chondro-costal Articulations:*—are formed by the cup-like cavities of the ribs with the convexities of the costal cartilages united together by the fibrous tissue of the periosteum of the ribs.

3. *Chondro-or Costo-sternal Articulations:*—

A. S.—The convex facets of the sternal (true) costal cartilages and the oval depressions formed by the sternebræ.

M. of U.—3 ligaments.

(a) The *Superior Costo-sternal* extends superiorly.

(b) The *Inferior Costo-sternal* extends inferiorly.

(c) The *Capsular* envelopes the joint.

S. M.—One for each joint on each side, except in the first in which one is common to both sides.

Mts.—Slight elevation and depression.

4. *Sternal Articulations* are formed by the sternebræ united together by intervening fibro-cartilages and the *common Superior Sternal Ligament.*

5. The *Asternal* (false) *costal cartilages* are united together by small yellow elastic ligaments at their free extremities.

Anterior Limb Articulations.

1.—The Shoulder or Scapulo-humeral joint (Enarthrosis) :—

A. S.—The scapular glenoid cavity and the humeral head.

S. of U.—One strong *Capsular* ligament attached to the margin of the glenoid cavity and the humeral neck, and assisted by the surrounding muscles viz :—the flexor brachii in front, the caput magnum and scapulo-humeralis posticus behind, the antea-spinatus, postea spinatus and postea spinatus minor externally, and the subscapular tendon internally.

S. M.—Single.

Mts.—*Extension* by the antea-spinatus and levator humeri ; *Flexion* by the teres externus, coraco-humeralis, latissimus dorsi, teres internus, postea-spinatus minor, scapulo-humer alis posticus, and caput magnum of the Triceps extensor brachii ; *Abduction* by the teres externus, postea-spinatus and posteaspinatus minor ; *Adduction* by the coraco-humeralis, subscapu-laris and Pectoralis transversus and anticus ; *Rotation outwards*, by the teres externus, postea spinatus minor and postea-spinatus ; and *Rotation inwards* by the levator humeri, latissimus dorsi and teres internus.

2.—The Elbow or Brachio-humeral joint (Diarthrosis Ginglymus).

A. S.—The humeral inferior extremity and the radial superior extremity with the ulnar olecranon process.

M. of U.—3 ligaments.

(a) The *Capsular* envelopes the joint and is in relation anteriorly with the flexor brachii tendon and posteriorly with the Triceps extensor brachii and anconeus.

(b and c) The *External* and *Internal Laterals* extend from the external and internal condyles to the respective sides of the radial head and are in relation, respectively, with the anterior radial vessels and radial nerve, and the posterior radial vessels and ulnar nerve.

S. M.—Single.

Mts.—*Flexion* by the flexor brachii and humeralis obliquus; *extension* by the Triceps extensor brachii, anconeus and Scapulo ulnaris.

3.—The Radio ulnar joint:—

A. S.—The two diarthrodial facets and the two synarthrodial surfaces of the radius with those of the ulna.

M. of U.—4 ligaments.

(a and b) The *Superior* and *Inferior Arciform* or *Radiating* attached on both sides to the radius and ulna, respectively above and below the radio-ulnar arch.

(c and d) The *Superior* and *Inferior Interosseous* placed respectively above and below the radio-ulnar arch between the two synarthrodial surfaces of the radius and ulna. The former rarely, and the latter always, ossifies at adult age.

4.—The Carpal, Knee or Wrist joint (Diarthrosis Ginglymus).

Includes (A) the *Superior Carpal* joints between the bones of the upper carpal row, (B) the *Inferior Carpal* joints between the bones of the lower carpal row, (C) the *Radio-carpal* joint between the radial inferior extremity and the upper surfaces of the bones of the upper carpal row, (D) the *Intercarpal* joints between the bones of the two carpal rows, and (E) the carpo-metacarpal joint between the lower surfaces of the bones of the lower carpal row and the upper surfaces of the metacarpal bones.

M. of U.—The special and common ligaments.

A.—The *Special* ligaments for the *Superior Carpal:*—

The *Three anterior* placed anteriorly to, and the *three interossei* placed between, each pair of super-carpal bones.

B.—The *Special* ligaments for the *Inferior Carpal.*

The *two anterior* placed anteriorly to, and the *two interossei* placed between, each pair of lower carpal bones.

C.—The *Special* ligaments for the *Radio-Carpal* :—

(a) The *oblique*, (b) the *Superior Trapezial*, and (c) the *third* ligament. They all extend from the external side of the radial inferior extremity, and the first runs obliquely inwards and posteriorly to the scaphoid, the second to the trapezium, and the third to the os lunare posteriorly.

D.—The *Special* ligaments for the Inter-carpal :—

(a) The *first* extends vertically from the scaphoid to the trapezoid and os magnum, (b) the *second* obliquely from the cuneiform to the os magnum, and (c) the *third* (Inferior Trapezial) from the trapezium to the unciform and head of the outer splint bone.

E.—The *Special* ligaments for the Carpo-metacarpal :—

(a & b) The *two anterior* unite the os magnum and unciform to the large and outer small metacarpals respectively, (c & d) the *two posterior* unite the os magnum and trapezoid to the large and inner small metacarpals respectively, and (e & f) the *two interossei* unite the heads of the respective splint bones to the large metacarpal and lower carpals.

THE COMMON LIGAMENTS for all the carpal joints are:—

(a).—The *Anterior Common* or *Capsular* attached anteriorly to the radius, both rows of carpal bones and the head of the large metacarpal.

(b).—The *Posterior Common* attached posteriorly to the transverse crest of the radius, both rows of carpal bones and the head of the large metacarpal.

(c).—The *Internal lateral* consists of two crucial bands, superficial and deep, which arise from the inner side of the radial inferior extremity, and respectively go to the os magnum and head of the large metacarpal, and to the scaphoid, trapezoid and inner splint head.

(d).—The *External lateral* consists of superficial and deep sets, which arise from the outer side of the radial inferior extremity,

and respectively go to the outer splint head, and to the cuneiform, unciform, and outer splint head.

S. M.—Four; one small between the trapezium and cuneiform, and three large between the radius and upper carpals between the two carpal rows, and between the lower carpals, and metacarpus. Sometimes a fifth one is present between the trapezoid and pisiform (when present).

Mts.—Chiefly in the radio-carpal, somewhat in the intercarpal, and very slight in the carpo-metacarpal joints. *Flexion* by the flexor metacarpi externus, -medius, -internus, and the flexor pedis perforans and perforatus; *extension* by the extensor metacarpi magnus,—obliquus, extensor pedis, and -suffraginis; and slight *gliding motion.*

5.—The Intermetacarpal joints (Arthrosis):—

Each splint bone articulates with the large metacarpal by 2 diarthrodial facets and a synarthrodial surface, and is united by an *interosseous* ligament which often ossifies, and the *carpal* ligaments (above mentioned).

6.—The Fetlock or Metacarpo-(metatarso)-phalangeal joint (Diarthrosis Ginglymus.)

A. S.—The inferior extremity of the cannon and the superior extremity of the os suffraginis with the anterior surfaces of the two sesamoids.

M. of U.—3 *proper* and 7 *accessory* ligaments.

The *Proper ligaments* are :—

(a) The *Anterior* or *capsular* extends anteriorly from the cannon to the os suffraginis.

(b and c) The *External* and *Internal Laterals* extend from the buttons of the splint bones and the infero-lateral aspects of the cannon to the supero-lateral aspects of the os suffraginis on their respective sides.

The Accessory ligaments are :—

(a) The *Superior Sesamoidean* or *Suspensory* arises posteriorly from the lower carpals (or tarsals) and the cannon head, and lies between the splint bones, at whose inferior ends it bifurcates sending each branch to the summits of the sesamoids, from whence two branches pass downwards and forwards to become reunited to form the *broad ligament*, which is ultimately attached to the antero-inferior part of the os suffraginis. It is in relation anteriorly with the large metacarpal (or metatarsal) vessels, laterally with the digital vessels and nerves and posteriorly with the flexor pedis perforans and perforatus.

(b, c, and d) The *Superficial*—(external or Y shaped),*Middle*—(V shaped), and *Deep* (internal or X shaped) *inferior sesamoidean* extend from the base of the sesamoids to the supero-posterior part of the os coronæ, to the infero-posterior part of the os suffraginis, and to the supero-posterior part of the os suffraginis, respectively.

(e and f) The *external* and *internal lateral sesamoidean* extend from the respective sides of the sesamoids to the respective tubercles on the head of the os suffraginis. They are in relation with the digital vessels and nerves.

(g) The *Intersesamoidean* placed between the two sesamoids posteriorly.

S. M.—Single, when abnormally full it forms 'wind galls' between the two branches of the suspensory ligament.

Mts.—*Flexion* by the flexor pedis perforans and perforatus, *extension* by the extensor pedis and—suffraginis, and *slight lateral motion.*

In the posterior fetlock, flexion is effected by the flexor pedis perforans,-perforatus, and accessorius, and extension by the extensor pedis, extensor pedis brevis and peroneus.

7.—**The Pastern or Proximal Interphalangeal joint** :—(Diarthrosis Ginglymus).

A. S.—The inferior extremity of the os suffraginis and the superior extremity of the os coronæ with the glenoidal fibro-cartilage posteriorly.

M. of U.—5 ligaments.

(a) The *Capsular* surrounds the joint.

(b and c) The *External* and *internal lateral* attached above to the infero lateral tubercles of the os-suffraginis, and below, after passing obliquely downwards and backwards, to the postero-lateral parts of the os coronæ.

(d and e) The *two posterior* ; each arises by 3 points-superior, middle and inferior-on the sides of the os suffraginis, and is attached below the *glenoidal* fibro-cartilage and to the postero-superior border of the os coronæ.

S. M.—Single and covers the glenoid cartilage, between which and the os suffraginis it forms a *cul-de-sac.*

Mts.—Flexion by the flexor pedis perforans and perforatus, *extension* by the extensor pedis and *slight lateral motion* during flexion.

In the posterior pastern, flexion and extension are assisted by the flexor pedis accessorius, and by the extensor pedis brevis and peroneus, respectively.

8.—**The Coffin or Distal Interphalangeal joint** :—(Diarthrosis Ginglymus).

A. S.—The inferior surface of the os coronæ and the superior surfaces of the os pedis and the navicular bone. Also the postero-superior border of the os pedis and the anterior border of the navicular bone.

M. of U.—8 ligaments.

(a and b) The *two anterior* (external and internal) attached

above to the lateral imprints of the os coronæ, and below to the two depressions on the superior border of the os pedis.

(c and d) The *two posterior* (external and internal) attached above to the postero-lateral parts of the os coronæ and below to the superior border of the navicular bone, where they join each other and form an elastic fibrous cord-(e) the *Superior navicular* or *broad ligament*, and from the angles of the navicular bone they give off short *lateral* fasciculi—(f and g) the *external* and *internal navicular ligaments*—which join the navicular angles to the pedal wings and the inner surfaces of the lateral cartilages.

(h) The *Inferior navicular* or *Interosseous* attached to the anterior rough navicular groove and to the pedal Semilunar ridge.

S. M.—Single, and sends a large *cul-de-sac* upwards and backwards, and 2 small ones laterally which are liable to be opened in the operation for diseased lateral cartilages.

Mts.—*Flexion* by the flexor pedis perforans and *extension* by the extensor pedis.

In the hind coffin-joint, the flexor accessorius and the extensor pedis brevis and peroneus also take part in flexion and extension respectively.

Articulations of the Posterior (Hind) Limb.

1.—The Sacro-Iliac joint (Amphiarthrosis.):—

A. S.—The 'auricular' facets on the supero-lateral surface of the sacrum and on the venter ilii with intervening cartilages.

M. of U.—4 ligaments—3 proper and 1 accessory.

(a) The *inferior sacro-iliac* envelopes the joint like a capsular ligament and is attached above to the venter ilii and below to the sacral transverse process.

(b) The *superior sacro-iliac* extends from the posterior iliac spine to the supersacral spine.

(c) The *Lateral sacro-iliac* runs obliquely backwards from the posterior iliac spine and internal (superior) iliac border to the postero-lateral border of the sacrum.

(d) The *Sacro-sciatic* or *Ischiatic* ligament is an accessory one, attached above to the postero-lateral border of the sacrum and of the first 2 and 3 coccygeal vertebræ, and below to the superior ischiatic spine and ischial tuberosity. This ligament forms with the iliac and ischial shafts two notches, respectively called the *great sciatic* and the *lesser sciatic notches*, the former giving passage to the great sciatic nerve and gluteal blood vessels, and the latter to the obturator internus and pyriformis tendons.

S. M.—Single lining the inferior sacro-iliac ligament.

Mts.—Slight gliding motion.

2.—The Ischio-pubic or Pelvic Symphysis (Amphiarthrosis) :—

A. S.—The internal borders of the ischium and pubis of both coxæ.

M. of U.—The superior and inferior transverse bundles of white fibres and an interosseous cartilage which ossifies at adult age.

3.—The Femoro-Pelvic or Hip joint (Enarthrosis) :—

A. S.—The femoral head and the acetabulum of the coxa.

M. of U.—5 ligaments— 3common and 2 special.

The *special ligaments* :—

(a) The *cotyloid* surrounds and deepens the acetabulum, and where it bridges over the cotyloid notch it is called (b) the *Transverse* ligament.

The *Common ligaments* :—

(a) The Capsular attached to the acetabulum (brim) and the femoral neck. It is in relation anteriorly with the crureus and rectus femoris—posteriorly with the gemelli, obturator internus and pyriformis—supero-externally with the gluteus externus—and infero-externally with the obturator externus, muscles.

(b) The *Round, coxo-femoral* or *ligamentum teres* extends from the notch in the femoral head to the fundus acetabuli.

(c) The *Pubio-femoral* is a continuation of the *prepubian tendon* —the common tendon of the abdominal muscles. It arises from the anterior border of the pubis and pubic symphysis and runs outwards and backwards along the groove on the pubic inferior surface and through the cotyloid notch, to be inserted into the notch on the femoral head. (It is present in the Equidæ only, in whom the abduction of the limb is very much restricted.)

S. M.—Single, covering the round and pubio-femoral, and lining the capsular and cotyloid, ligaments.

Mts.—*Flexion* by the sartorius, pectineus, psoas magnus, iliacus, tensor fasciæ latæ, rectus femoris, and rectus parvus; *extension* by the adductor magnus, gluteus maximus, and obturator externus; *abduction* by the gluteus externus, triceps abductor femoris (anterior portion), gluteus maximus and internus; *adduction* by the sartorius, gracilis, adductor longus,—magnus and—brevis, and pectineus; *rotation inwards* by the sartorius and gracilis; and *rotation outwards* by the gluteus internus, adductor brevis, psoas magnus, iliacus, obturator externus and internus, pyriformis, and gemelli.

4.—The Femoro-tibial or Stifle joint (Diarthrosis Condyloid) :—

A. S.—The femoral trochlea and condyles articulate respectively with the posterior surface of the patella, and the superior extremities of the tibia and fibula.

M. of U.—Two groups of ligaments viz.,—the *Patellar* and the *Femoro tibial.*

The *Patellar Group* consists of 6 ligaments :—

(a) The *Capsular* attached round the femoral trochlea and the patellar articular surface.

(b and c) The *external* and *internal laterals* extend from

lateral ridges above the femoral condyles to the respective borders of the patella.

(d, e, and f) *Three straight*, (external, middle and internal) extend from the antero-inferior surface of the patella to the anterior tibial tuberosity on their respective sides.

The *Femoro-tibial Group* consists of 5 proper ligaments, and 2 menisci with their 5 coronary ligaments.

The *Proper Femoro-tibial ligaments* are :—

(a and b) The *anterior and posterior*, (or the external and internal,) *crucial* or *interosseous* extend from the postero-external and antero-internal sides of the femoral intercondyloid groove to the tibial spine and to a small tubercle behind the inner articular tibial surface, respectively. The anterior is crossed behind by the posterior ligament.

(c and d) The *External* and *Internal Laterals* extend from the femoral condyles to the external and internal tibial tuberosities.

The external also attached below to the fibular head.

(e) The *Capsular* or *Posterior* encircles the joint posteriorly where it is in relation with the popliteal vessels, and is attached to the femur, tibia, menisci and lateral ligaments.

The *Menisci*, or *Interarticular or Semilunar fibro-cartilages*, are two crescentic fibro-cartilaginous discs, concave above and flat below, placed between the femoral condyles and the tibial head. The *internal*, larger and thinner, is attached to the bones by 2 coronary ligaments-an anterior and a posterior-which are respectively attached, below, in front of and behind the tibial spine. The *external* is attached by 3 coronary ligaments, an anterior and 2 posterior. The anterior goes in front of the tibial spine, the supero-posterior to the intercondyloid notch above, and the infero-posterior to the external tibial tuberosity below and posteriorly.

S. M.—Three, a superior placed between the trochlea and

the patella, and 2 laterals between the femoral condyles and the tibial head.

Mts.—*Flexion* by the triceps abductor femoris (posterior portion), biceps rotator tibialis, and popliteus; *Extension* by the vastus internus and externus, rectus femoris, and triceps abductor femoris (anterior portion); *Rotation outwards* by the triceps abductor femoris (posterior portion); *Rotation inwards* by the biceps rotator tibialis and popliteus.

5.—**The tibio-fibular joint** (Arthrodia):—

A. S.—The facet on the external tibial tuberosity and that on the fibular head.

M. of U.—The *capsular* ligament envelops the articular facets. The fibula is also attached to the tibia by two interosseous ligaments—a superior and an inferior—and by a ligamentous cord which extends from the fibula to the external malleolus.

6.—**The Tarsal or Hock joint** (Diarthrosis Ginglymus):—

Includes (A) the *Tibio-tarsal joint* between the tibial inferior extremity and the trochlea of the astragalus; (B) the *Superior tarsal* (calcaneo-astragaloid) *joint* between the posterior surface of the astragalus and the anterior surface of the body of the os calcis; (C) the *Inferior tarsal joints* between the internal surface of the cuboid and the external borders of the cuneiform magnum and medium, between the inferior surface of the cuneiform magnum and the superior surfaces of the cuneiform medium and parvum, and between the internal border of the cuneiform medium and the anterior extremity of the cuneiform parvum; (D) the *Intertarsal joint* between the inferior surface of the astragalus and the superior surfaces of the cuboid and cuneiform magnum, and between the inferior surface of the os calcis (body) and the superior surface of the cuboid; and (E) the *Tarso-metatarsal* joint between the inferior surfaces of the lower tarsals (the cuboid and

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cuneiform medium and parvum) and the superior surfaces of the metatarsal bones.

M. of U.—The special and common ligaments.

The *Common Ligaments* are :—

(a) The *Capsular* (often described as double and named the anterior and posterior) is attached above *round* the inferior tibial articular surface and below *anteriorly* to the inferior border of the astragalus, to the cuneiform magnum and medium and the oblique ligament, and below, *posteriorly*, to the calcis and astragalus. It is in relation anteriorly with the anterior tibial artery.

(b) The *Internal lateral* consists of 3 bands—the superficial middle and deep—which arise from the internal malleolus and go to the the inner sides of the astragalus, 3 cuneiforms, and large and inner small metatarsals—to the inner sides of the astragalus and calcis—and to the astragalus, respectively.

(c) The *External lateral* consists of 2 crucial—bands, the superficial and deep—which arise from the external malleolus and go to the external sides of the astragalus, calcis, cuboid, and large and outer small metatarsals, and to the astragalus and calcis, respectively.

(B).—The *Special* ligaments for the *superior tarsal* ;—

(a) The *Superior calcaneo-astragaloid* extends from the upper border of the astragalus to that of the calcis.

(b and c) The *External and Internal laterals* extend on the respective sides from the astragalus to the calcis.

(d) The *Interosseous* is placed between the articular facets.

(C).—The *Special* ligaments for the *inferior tarsal* :—

(a and b) The *two anterior*, named cuboido-scaphoid and cuboido-cunean, unite the cuboid to the cuneiform magnum and medium anteriorly and between them is the orifice of the cuboido-scaphoido-cunean canal for the perforating pedal artery.

(c, d and e) The *Three interossei* are placed between the cuboid and cuneiform magnum, between the cuboid and cuneiform medium, and between the magnum and medium cuneiforms and cuneiform parvum, respectively.

(D).—The *Special ligaments* for the *Intertarsal* :—

(a) The *Calcaneo-cuboid* or *Calcaneo-metatarsal* extends from the posterior border of the calcis to that of the cuboid and outer splint head, and is involved in the lesion known as '*curb*'.

(b) The *Oblique* or *Astragalo-metatarsal* extends from the inner tubercle of the astragalus to the posterior sides of the cuneiform magnum and medium and large metatarsal head, and covers the seat of '*Bone-spavin*'.

(c) The *Tarso-metatarsal* binds posteriorly all the tarsal bones to the three metatarsals, and is pierced by the perforating pedal artery and vein.

(d) The *Great Interosseous* unites the calcis and astragalus to the cuboid and cuneiform magnum.

(E).—The *Special* ligament for the *Tarso-metatarsal* :—

(a) The *Interosseous* is placed between the cuboid and cuneiform medium and parvum above, and 3 metatarsals below.

S. M.—Three ; one between the astragalus and tibia which when distended forms a 'bog-spavin', another between the two rows of tarsal bones, and the third between the lower tarsal bones and the metatarsus.

Mts.—*Flexion* by the extensor pedis, peroneus, and flexor metatarsi ; *Extension* by the Gastrocnemius externus, plantaris, and flexor pedis perforatus—perforans and—accessorius; and *slight abduction* due to the marked obliquity of the tibial articular grooves. The motion is chiefly in the tibio-tarsal joint and is almost void in others.

The remaining joints of the posterior limb viz,—the *metatarsal*, *metatarso-phalangeal* (fetlock) and *interphalangeal*, are like those of the anterior limb.

Myology.

The muscles are the active organs of motion and locomotion, the passive organs being the bones and ligaments. The average total weight of the muscles is nearly one-half the entire of the body but it varies with the species, age, sex, and state of health. The muscles are supplied with nerves, blood-vessels, and absorbents, and consist of a specific contractile substance called, '*Muscular Tissue*' and of areolar and fibrous tissues with a little of fat.

Muscular tissue is formed of contractile fibres called muscular fibres which are of 2 kinds viz, striated or voluntary and non-striated or involuntary. Exceptionally some fibres which are striated are involuntary and *vice versa*,—as seen in the muscle fibres of the heart, pharynx, upper part of the gullet, internal ear, urethra &c. where they are striated but involuntary, and in the ciliary muscle of the eye which though nonstriated is voluntary.

Table showing the differential characters of striated and non-striated muscular fibres :—

Muscular tissue.

First Variety.	Second Variety.
1.—Striated or striped i.e. having transverse dark and light striæ or stripes at regular intervals.	1.—Non-striated or plain.
2.—Voluntary, i.e. under the control of the will.	2.—Involuntary.
3.—Dull red in colour.	3.—Pale.
4.—Terminating at one or both extremities in tendons which attach them to the bones.	4.—Never terminating in tendons.
5.—Consists of bundles or fasciculi of fibres enveloped in an outermost sheath of *coarse* connective tissue, the *Perimysium*.	5.—Consists of bundles of fibres enclosed in an outermost sheath of *finer* connective tissue the *Perimysium*
6.—Fasciculi generally run parallel to each other.	6.—Often cross each other forming a network.
7.—Each fasciculus is covered by a layer of *coarse* connective tissue, the *Endomysium*.	7.—Each fasciculus is covered by a layer of *finer* connective tissue, the *Endomysium*.
8.—Each fasciculus consists of several fibres held together by inflections from the endomysium.	8.—Held together by a transparent semifluid albuminous cementing intercellular substance.
9.—Fibres are cylindrical or prismatic in shape.	9.—Cylindrical only.

(Continued).

10.—Fibres are coarser, from $\frac{1}{400}$ to $\frac{1}{700}$ of an inch in diameter.

11.—Each fibre consists of an external delicate homogeneous tubular elastic sheath—the *Sarcolemma* or *Myolemma* and

12.—Within the sarcolemma are seen oval elongated nucleated cells,-the *muscle corpuscles*—, and fine filaments called *fibrillæ*. Each fibrilla consists of a single row of rectangular spaces separated by transverse doubly-refracting dark lines—the *Krause's membranes*—and presenting a broad central dark quadriangular and doubly refracting spot—the *central (transverse) contractile disc*—with a light singly-refracting quadriangular and narrow spot on its either side—the *lateral discs*. The central contractile disc consists of a number of rod-shaped bodies called *Muscle rods* or *Sarcous Elements*, in which exists the inherent power of contractility, and the lateral discs are generally transparent but sometimes present granular appearance.

10.—Finer from $\frac{1}{2000}$ to $\frac{1}{3000}$ of an inch in diameter.

11.—Sarcolemma absent, and

12.—Each fibre consists of an elongated or spindle-shaped contractile cell with an oblong elongated nucleus imbedded in a fibrillar stroma. These cells are called the contractile cells of Kolliker.

(Continued).

13.—Blood-vessels plentiful and the capillaries arranged longitudinally with transverse connecting branches.

14.—The nerves are from the cerebro-spinal system.

15.—Forms the whole class of the voluntary muscles, and is found in the diaphragm, the muscles of the external and middle ears, larynx, pharynx, tongue, soft palate, upper half of the gullet, and the heart, and the walls of the large veins at the point where they open into the heart.

13.—The transverse connecting capillary branches are absent.

14.—From the sympathetic system.

15.—Forms the muscular coat of the digestive tract from the lower half of the œsophagus to the internal sphincter ani, the trachea, bronchii, gall-bladder, ductus communis choledochus, pelves and calices of the kidneys, ureters, bladder and urethra. It also exists in the ducts of glands, the capsule and trabeculæ of the spleen, the mucous membranes forming the *muscularis mucosæ*, the arteries, veins and lymphatics, the iris and ciliary muscle, the skin, and, *in the male*, in the dartos scroti, vas deferens, epididymes, vesiculœ seminales, prostate gland and corpora cavernosa, and, *in the female*, in the Fallopian tubes, uterus (enormously developed in pregnancy), vagina, broad ligaments and the erectile tissue of the clitoris.

Tendons are white glistening slightly elastic cords of white fibrous tissue mixed with a few yellow fibres. They attach the muscles to the bones, and are invested in a connective tissue sheath and sparingly supplied with blood-vessels and nerves. They are of 2 kinds viz., round and cord-like called *Funicular* tendons, and flattened and expanded called *Aponeurotic* tendons or *aponeuroses*, which are white irridescent fibrous membranes destitute of nerves.

The *appendages* of the muscles are the fasciæ bursæ and tendinous sheaths :—

Fascia is a white fibrous strong membranous expansion enclosing a group of muscles or delicate organs (as in the pelvis) and firmly connected with the bones. It is of 2 kinds, (a) *Fibro-areolar* or *Superficial* fascia, and (b) *Aponeurotic* or *Deep* fascia.

The Superficial Fascia lies immediately beneath the skin and consists of two or more layers of elastic fibro-areolar tissue containing in its meshes adipose cells. Between its layers are found the superficial vessels, nerves, and lymphatics with glands and certain cutaneous muscles, as the Platysma or Panniculus Carnosus and the Orbicularis Palpebrarum. It connects the skin to the subjacent parts, facilitates its movement, serves as a matrix for the passage of blood-vessels and nerves to the skin, and retains the warmth of the body through its adipose tissue—the fat being a bad conductor of heat.

The **Deep or Aponeurotic Fascia** is a dense inelastic fibrous membrane, which is very thick in unprotected situations as on the outer side of limbs. It assists the muscles in their action and sometimes contains a distinct muscle in its layers by which it is rendered tense, e.g., the tensor fasciæ latæ. It is subdivided into 2 classes viz., (a) *the aponeurosis of insertion*, which serves for the insertion of muscles on bones &c., and (b) *the aponeurosis of*

investment, which forms a sheath for a group or groups of muscles as well as for each muscle and serves for the origin of muscles.

Bursæ are small circular *serous* or *mucous* cavities filled with a serous fluid and situated on the prominent points of bones over which the muscles glide.

Tendinous Sheaths are fibrous or osseo-fibrous grooves for the gliding of tendons when they turn from their original direction, and the *tendinous synovial sheaths* are synovial membranes lining the tendinous sheaths and covering the tendons, and contain a little joint-oil to lubricate the tendons.

Muscular Nomenclature :—The muscles are named

(a) *from their form*, as the rhomboideus, trapezius, penniform &c;

(b) *from the number of their divisions*, as the biceps (two-headed), digastric (two bellied with a mesian tendon) &c ;

(c) *from their use*, as flexor, abductor, rotator &c ;

(d) *from their direction*, as rectus, transversus, obliquus &c ; and

(e) *from their situation or attachment*, as the Temporalis, Coraco radialis, Sterno-thyro-hyoideus, Tibialis &c.

Classification of Muscles :—The muscles are primarily classified into 5 regions according to the situations they occupy viz,— Subcutaneous, Head, Trunk, Pectoral limb, and Pelvic limb, each of which except the first consists of several groups of muscles and each group is formed of several muscles.

The *Origin* of a muscle is its proximal or central attachment which usually remains fixed when the muscle contracts, and the *Insertion* of a muscle is its distal attachment or termination and is the movable portion of the muscle.

Tabular View of the clafication of muscles.

Regions.	Groups.	Names of muscles.
I. Subcutaneous.		* Panniculus Carnosus.
II. Head.	Anterior Maxillary.	(12). Zygomaticus, Buccinator,* Orbicularis oris, Levator labii superioris alæque nasi, Nasalis longus, Dilatator naris lateralis,—*transversalis,—inferioris, and—superioris, Depressor labii superioris, and—inferioris, and Levator labii inferioris.
	Posterior Maxillary.	(6). Masseter, Temporalis, Stylo-maxillaris, Pterygoidei internus and externus, and Digastricus.
	Hyoidean.	(6). Mylo-hyoideus, Genio-hyoideus, Hyoideus magnus,—parvus and*—transversus, and Stylo-hyoideus.
	Lingual (Glossal).	A.—*Extrinsic*, (6) :—Hyo-glossus longus,—brevis, and—parvus, Genio-hyo-glossus, Pharyngo-glossus, and Palatoglossus.
		B.—*Intrinsic*, (1)* Lingualis.
	Soft Palatine.	(5). Tensor palati, Levator palati, Pharyngo-staphylinus, Palato-staphylinus, and Palato-glossus.
	Pharyngeal.	(7). Pharyngo-staphylinus, and Pterygo—, Kerato—, Hyo—, Thyro—, Crico—, and Aryteno—*pharyngeus*.
	Laryngeal.	A.—*Extrinsic*, (3):—Sterno-thyro-hyoideus, Hyo-thyroideus, and * Hyo-epiglottideus.
		B.—*Intrinsic*, (5) :—Crico-thyroideus, Crico-arytenoideus posticus and—lateralis, Thyro-arytenoideus, and * Arytenoideus.

* *They are single muscles in the body. The others exist in pairs.*

(*Continued.*)

Regions.	Groups.	
II. Head.—(*Continued*).	Palpebral.	(4). Orbicularis palpebrarum, Lachrymalis, and Levator palpebræ superioris externus and—internus.
	Orbital.	(8). Retractor oculi, Rectus superioris,—inferioris,—externus,and—internus, Obliquus superioris and—inferioris, and Supernumerary oblique.
	External Auricular.	A.—*Extrinsic*, (8).—Attolens maximus,—anticus, and—posticus, Retrahens externus,—medius and—internus, Mastoido-auricularis and Abducens. B.—Intrinsic, (2).—Scuto-auricularis, externus and—internus.
	Internal Auricular.	(3). Stapedius, Tensor tympani, and Laxator tympani.
III. Trunk.	Cervical.	*Inferior*:—(8) Sterno-maxillaris, sterno-thyro-hyoideus, Subscapulo hyoideus, Rectus capitis anticus major and—minor, Rectus capitis lateralis, Scalenus, and * Longus Colli. *Lateral*:—(14) Levator humeri, Trapezius cervicalis, Rhomboideus longus, Serratus magnus, Splenius, Trachelo-mastoideus, Complexus major and—minor, Rectus capitis posticus major and—minor, Obliquus capitis anticus and—posticus, Spinalis colli, and Intertransversalis colli.
	Costal.	(8). Trapezius dorsalis, Rhomboideus brevis, Lattissimus dorsi, Serratus magnus, Superficialis—Transversalis—and Levatores costarum, and Intercostales.

* *They are single muscles in the body. The others exist in pairs.*

(Continued.)

Regions.	Groups.	Names of muscles.
III. Trunk. *(Continued).*	Pectoral.	(4) Pectoralis transversus,—magnus,—anticus, and—parvus.
	Sternal.	(2). Lateralis sterni and Triangularis sterni.
	Dorsal-lumbar.	(4). Longissimus dorsi, Spinalis dorsi, Semispinalis dorsi et lumborum, and Intertransversales lumborum.
	Adominal.	(4). Obliquus abdominis externus and—internus, Rectus abdominis, and Transversalis abdominis (and Tunica abdominalis and Linea alba).
	Sublumbar.	(4). Psoas magnus and——parvus, Iliacus, and Quadratus lumborum.
	Diaphragmatic.	(1). *Diaphragm.
	Coccygeal.	(4). Erector—, Depressor—, Curvator—, and Compressor Coccygis.
	Perineal	(*Male*) :—(8). *Sphincter—Levator—and Retractor ani, Cremaster, Accelerator urinæ, Erector—and Retractor penis, and *Wilson's muscle.
		(*Female*) :—(7).—Sphincter—Levator—and Retractor ani, Erector clitoridis, and *Constrictor vulvæ anterior and—*posterior, and suspensory (muscular) ligament.

* *They are single muscles in the body. The others exist in pairs.*

(Continued.)

Regions.	Groups.	Names of muscles.
IV. Pectoral limb.	Scapular. (*Shoulder*).	*External Scapular* :—(4) Teres externus, Antea—and Postea spinatus, and Postea spinatus minor.
		Internal Scapular :—(3) Subscapularis, Teres internus, and Scapulo-humeralis posticus.
	Brachial (*arm*).	*Anterior brachial*:—(3) Flexor brachii, Coraco-humeralis, and Humeralis obliquus.
		Posterior Brachial:—(3) Scapulo ulnaris, Triceps extensor brachii, and Anconeus.
	Antibrachial (*forearm*).	*Anterior* (extensors) :—(4) Extensor metacarpi magnus and—obliquus, and Extensor pedis and—suffraginis.
		Posterior (flexors) :—(7) Flexor metacarpi externus,—medius and—internus, Flexor pedis perforatus and—perforans, and Ulnaris—and Radialis accessorius.
	Metacarpal (*fore-foot*).	(4). Two Interossei metacarpei, and two Lumbricales.
V. Pelvic Limb.	Gluteal (*hip*).	(9). Gluteus externus,—maximus and—internus, Rectus parvus, Obturator externus and—internus, Pyriformis, and Gemellus anticus and—posticus.
	Femoral (*thigh*).	*Internal* (adductors) :—(6) Sartorius, Gracilis, Pectineus, and Adductor brevis,—longus, and—magnus (Triceps adductor femoris).
		External (abductors) :—(1) Triceps abductor femoris.
		Anterior :—(5) Tensor fasciæ latæ, Rectus femoris, Vastus externus and internus, and Crureus.
		Posterior :—(2) Biceps rotator tibialis, and Ischio-femoralis.

(Continued.)

Regions.	Groups.	Names of muscles.
V. Pelvic Limb.	Tibial *(leg)*.	*Anterior* :—(3) Flexor metatarsi; Extensor pedis and Peroneus.
		Posterior :—(6) Flexor pedis perforatus (gastrocnemius internus),—perforans, and—accessorius, and Popliteus; Gastrocnemius externus and Plantaris.
	Metatarsal *(hind-foot)*.	(5). Two Interossei metatarsi, Two Lumbricales, and Extensor pedis brevis.

* *They are single muscles in the body. The others exist in pairs.*

Subcutaneous Region.

Panniculus Carnosus is a thin broad muscle lying under the skin over the greater part of the body and consists of 4 portions viz, :—

(a) the *Facial portion* extends anteriorly from the zygomatic arch to the angle of the mouth where it forms a distinct muscle, the RETRACTOR ANGULI ORIS, and blends posteriorly with

(b) the *Cervical portion*, which extends superiorly from the ligamentum nuchæ to the mesian fibrous raphe and cariniform cartilage inferiorly ;

(c) the *Thoracic portion* extends from the dorsal spines to the humeral internal trochanter covering the front and external side of the shoulder ;

(d) the *abdominal portion* is anteriorly continuous with the thoracic portion and posteriorly terminates in an angle at the groin and stifle joint. It is attached superiorly to the dorsal and lumbar spines by means of a thin fascia, and inferiorly to the abdominal tunic about 3 to 4 inches external to the umbilicus.

Action :—It wrinkles the skin and thus removes insects and offending bodies like the human hand.

Nervous Supply :—The terminal branch of the Superior Maxillary division of the 5th Cranial nerve, the Cervical branch of the Facial Nerve, the inferior branches of the Cervical, Dorsal and 1 or 2 Lumbar Spinal nerves, and the thoracic branch of the Brachial Plexus.

II. Head Region.

☞(In the following pages O= *origin*, I= *insertion*, A= *action*, N= *nervous supply* & R= relations of a muscle.)

A—Anterior Maxillary Group.

1.—*Zygomaticus*:—O.—Fascia of masseter muscle, near maxillary spine. I.—Buccinator muscle, near angle of the mouth. A.—Retracts (raises) angle of mouth. N.—(Temporal facial of) 7th.

2.—*Buccinator* :—O.—(Superficial portion or Caninus) Median raphe of the muscle ; (Deep portion) Alveolar tuberosity and three last molar alveoli of both jaws. I.—Superior and inferior interdental spaces and blends with orbicularis oris at angle of mouth respectively. A.—Retracts angle of mouth and compresses the cheek thus keeping the food between upper and lower molars. N.—The Facial and Buccal branch of Inferior Maxillary division of 5th. R.—Stenson's duct and glosso-facial (submaxillary) blood-vessels externally ; buccal mucous menbrane internally: and superior and inferior buccal glands superiorly and inferiorly.

3.—*Orbicularis Oris.*—Surrounds the mouth like a *sphincter.* A.—Closes the lips as in mastication, suction and prehension of food. N.—Facial or 7th.

4.—*Levator labii superioris alœque nasi.*—O.—Frontal and nasal bones. I.—(anterior division) Outer wing of nostril and upper lip; (posterior division) Angle of mouth. A.—Dilates the nostril and elevates the upper lip and angle of mouth. N.—(Temporal facial of) 7th. R.—Superior labial or coronary artery internally.

5.—*Nasalis longus.*—O.—The superior maxilla at its junction with malar and lachrymal bones below the orbit. I.—Extremity of nose and upper lip. A.—Singly, pulls the upper lip to one side; with its fellow, elevates it vertically. N.—(Temporal facial of) 7th nerve.

6.—*Dilatator naris lateralis.*—O.—Supermaxillary spine. I. Outer wing of nostril and upper lip. A.—Dilates the nostril and retracts the upper lip. N.—(T. f. of) 7th. R.—Superior labial or coronary artery internally.

7. *Dilatator naris transversalis.*—O.—Nasal peak. I.—Superior surface of cartilaginous wings of nostrils. A.—Dilates the nostrils N.—(T. f. of) 7th.

8.—*Dilatator naris inferioris.*—O.—Upper free edge of the premaxilla and supermaxilla. I.—Skin of false nostril and cartilaginous prolongation of inferior turbinated bone. A.—Dilates the false nostril, and the proper nasal cavity. N.—(T. f. of) 7th.

9.—*Dilatator naris superiors.*—O.—Cartilaginous septum nasi at the nasal peak. I.—Skin of false nostril and cartilaginous prolongation of superior turbinated bone. A.—Dilates the false nostril and proper nasal cavity. N.—(T. f. of) 7th.

10.—*Depressor labii superioris.*—O.—(Premaxillary part of) superior interdental space. I.—Upper lip and nasal cartilages. A.—Depresses the upper lip and thus dilates the nostrils. N.—(T. f. of) 7th.

11.—*Levator labii inferioris.*—O.—Inferior interdental space between the canine and corner incisor. I.—Lower lip. A.—Elevates the lower lip and presses it on the incisors. R.—Inferior labial or Cornary artery externally.

12.—*Depressor labii inferioris.*—O.—Alveolar tuberosity and superior border of inferior maxilla behind the last molar. I.—Lower lip. A.—Depresses (retracts) the lower lip; when singly pulls

it to one side. N.—(T. f. of) 7th. R.—Inferior labial or Coronary artery internally.

B. Posterior Maxillary Group.

The muscles of this group are masticatory and act upon the temporo-maxillary joint.

1.—*Masseter.*—O.—The malar zygoma, and superior maxillary spine and external surface. I.—Outer surface of vertical ramus of inferior maxilla. A.—Elevates the lower jaw, i. e. closes the mouth. N.—Masseter branch of inferior maxillary division of the 5th. R.—The branches of the facial nerve externally; the alveolar vein internally; the submaxillary (facial) artery, vein, and stenson's duct anteriorly; the transverse facial (branch of temporal) artery and vein supero-posteriorly, (the pulse is taken at this artery); and the maxillo-muscular vessels infero-posteriorly.

2.—*Temporalis.*— O.—Temporal fossa. I. Coronoid process of inferior maxilla. A.—Elevates and retracts the lower jaw with its fellow; singly, moves it laterally. N.—Buccal and masseter branches of I. M. of 5th. R.—A pad of fat lies between it and the ocular sheath (Periorbitale) anteriorly.

3.—*Stylo-maxillaris.*—O.—Occipital styloid process. I.—Angle, inferior maxilla. A.—Depresses and *retracts* the lower jaw. N.—Branch of the 7th.

4.—*Pterygoideus internus* (masseter internus).—O.—Sphenopterygoid process and palatine ridge. I.—Inner surface, vertical ramus of inferior maxilla. A.—Raises the jaw; singly, moves it laterally. N.—(Internal pterygoidean of) Inferior maxillary of 5th. R.—The inferior maxillary *(dental)* vessels and nerve and ramus of lower jaw externally; the guttural pouch, hyoid bone, hyoid muscles, hypoglossal and glosso-pharyngeal nerves, glosso-facial vessels, larynx, pharynx, Wharton's duct and submaxillary gland internally.

5.—*Pterygoideus externus.*—O.—Wing and pterygoid process, sphenoid. I.—Neck, inferior maxilla. A.—Raises and *protracts* the lower jaw; singly, moves it laterally. N.—(Buccal of) Inferior maxillary of 5th. R.—The temporo-maxillary joint externally.

6.—*Digastricus.*—O.—Occipital styloid process. I.—Inner surface, near symphysis, of inferior maxilla. Its intermediate tendon plays through a ring in the hyoideus magnus tendon at the body of the hyoid bone. A.—Raises the hyoid bone upwards and forwards, and upwards and backwards, during the 1st and 3rd acts of deglutition by its anterior and posterior belly respectively. It also retracts and lowers the inferior jaw (opens the mouth). N.—(anterior belly) Mylo-hyoidean of inferior maxillary of 5th; (posterior belly) styloid of the 7th. R.—(Posterior belly), Parotid gland externally; Guttural pouch, submaxillary gland, larynx, pharynx, external carotid artery with its lingual and facial branches, internal carotid artery, internal jugular vein, and hypoglossal nerve internally.

C. Hyoidean group.

1.—Mylo-hyoideus.—O.—Mylo-hyoid line, inferior maxilla, below the molar alveoli. I.—Inferior surface of hyoid body and spur process, and median raphe. A.—Raises the hyoid bone upwards and forwards and with it the base of the tongue during the first act of deglutition. N.—(Mylo-hyoidean of) Inferior Maxillary of 5th. R.—The sublingual gland, Wharton's duct, hypoglossal and lingual (gustatory) nerves, and buccal mucous membrane internally.

2.—Genio-hyoideus.—O.—Inner surface, near symphysis, of inferior maxilla. I.—hyoid, spur process. A.—Assists mylo-hyoideus. N.—The Hypoglossal or 12th.

3.—*Hyoideus Magnus.*—O.—Postero-inferior angle of hyoid cornu. I.—hyoid, heel process. A.—Draws the hyoid bone up-

wards and backwards and with it the tongue and larynx during the third act of deglutition. N.—The 7th or Facial. R.—The pharynx, guttural pouch, and hypoglossal nerve internally; the external carotid and glosso-facial arteries, and glosso-pharyngeal nerve anteriorly between it and the hyoid cornu.

4.—*Hyoideus Parvus.*—O.—Hyoid cornu and corniculum at their junction. I.—Hyoid body and heel process. A.—Elevates the heel process and with it the laryx by approximating the hyoid segments. N.—The 9th or glosso-pharyngeal. R.—The lingual artery externally.

5.—*Hyoideus Transversus.*—Extends transversely between the hyoid cornicula. A.—Approximates the cornicula and raises the root of the tongue. N.—The 9th.

6.—*Stylo-hyoideus.*—O.—Occipital styloid process. I.—Superoposterior part of the hyoid cornu. A.—Flexes the temporohyoideal joint and thus draws the hyoid bone backwards and downwards with the parts attached to it. N.—the 7th or Facial. R.—Parotid gland externally; guttural pouch internally. In the operation for opening the pouch this muscle is peforated.

D. Lingual Group.

Extrinsic Muscles:—

1.—*Hyo-glossus Longus.*—O.—External surface of the hyoid cornu. I.—Substance of the tongue. A.—With its fellow, retracts the tongue within the mouth; singly, draws it to one side. N.—The 12th or Hypoglossal. R.—Sublingual gland and nerve, and Wharton's duct externally.

2.—*Hyo-glossus brevis.*—O.—Lateral aspect of the hyoid body and spur and heel processes. I.—Side of the tongue, whence the fibres pass inwards to constitute the 'Transversus Lingualis.' A.—Retracts and depresses the tongue and draws down the sides of

the tongue so as to render it convex from side to side. N.—the hypoglossal. R.—The hypoglossal nerve, Wharton's duct, and the lingual mucous membrane externally; the lingual artery and the glosso-pharyngeal nerve internally.

3.—*Hyo-glossus parvus.*—O. Inner side of the hyoid body and corniculum. I.—Dorsum and sides of the tongue. A.—Retracts the tongue. N.—The Hypoglossal.

4.—*Genio-Hyo-glossus.*—O.—Depression near the inferior maxillary symphysis. I.—Substance of the tongue. Its fibres radiate *downwards and backwards* into the hyoid body and base of the tongue, *upwards* into the centre of the tongue, and *forwards* into the tip of the tongue. A.—Carries the tongue forwards—i.e. protrudes it, draws it downwards so as to make it concave from side to side forming a channel along which fluids pass towards the pharynx as in sucking, and draws the tongue back into the mouth. N.—The hypoglossal.

5.—*Pharyngo-glossus.*—O.—Lateral wall of the pharynx. I.—Hyoid intercornual joint and root of the tongue. A.—Retracts the tongue and brings the pharynx and tongue close together. N.—The hypoglossal and the pharyngeal plexus.

6.—*Palato-glossus.*—O.—Anterior pillar of the soft palate. I.—Root of the tongue. A.—Narrows the fauces and draws the tongue base upwards. N.—Palatine branch of Spheno-palatine or Meckel's ganglion (7th nerve.)

Intrinsic Muscles:—

They are collectively described under the name Linguales and regarded by Chauveau and others as mere prolongations of the extrinsic muscles.

7.—*Lingualis.*—Consists of 2 layers (superior and inferior) of longitudinal fibres, which extend from the os hyoides to the tip of the tongue and form respectively the *Linguales Superioris*

(superficialis) and *Lingualis Inferioris*, an *intervening* set of transverse fibres which extend from one side of the tongue to the other and form the *Lingualis Transversus*, and a set of vertical fibres which decussate the three preceding and form the *Lingualis Verticalis*. A.—The *superioris* draws the tip of the tongue upwards and renders it concave from before backwards; the *inferioris* draws the tip downwards and renders the tongue convex from before backwards; the *transversus* contracts the tongue transversely, thus elongating it antero-posteriorly, and assists the hyo-glossus brevis in rendering the tongue convex from side to side; and the *Verticalis* assists the genio-hyo-glossus in rendering the tongue concave from side to side. N.—The Chorda tympani of the 7th.

E. Velum Pendulum Palatine Group.

1. *Tensor palati.*—O.—Petrosal styloid process and Eustachian tube. I.—Staphylline aponeurosis. Its terminal tendon glides over the hamular process of the pterygoid bone. A.—Tenses and depresses the anterior half of the soft palate as the staphylline aponeurosis lies in the anterior half only.

N.—Branch from Otic ganglion (5th nerve).

2.—*Levator palati.*—O.—Petrosal styloid process and Eustachian tube. I.—Posterior or pharyngeal surface of the soft palate. A.—Raises the velum and thus shuts off the communication between the pharynx and nasal chambers. N.—Petrosal branches of 7th nerve. R.—Externally, the tensor palati; internally, the Eustachian tube.

3.—*Pharyngo-staphylinus.*—O.—Posterior part of soft palate. I.—Posterior border of thyroid cartilage of the larynx, and the wall of pharynx. A.—Tenses the velum and draws its free edge upwards and backwards. N.—Pharyngeal plexus, glosso-pharyn-

geal nerve, and Palatine branch of spheno-palatine ganglion (7th nerve).

4.—*Palato-staphylinus.*—O.—Palatine arch and staphylline aponeurosis. I.—Free edge of the velum. A.—Raises and draws forwards the velum, thereby dilating the isthmus of the fauces. N.—Petrosal branches of 7th.

5.—*Palato-glossus.*—(vide p. 120).

F. Pharyngeal Group.

1.—*Pharyngo-staphylinus.*—(vide. p. 121).

2.—*Pterygo-pharyngeus.*—O.—sphenoid, pterygoid process. I.—Posterior median fibrous raphe of the pharynx. A.—Constricts the pharynx, and thus conveys the bolus backwards into the œsophagus. N.—Pharyngeal plexus.

3.—*Kerato-pharyngeus.*—O.—Inner surface of the hyoid cornu. I.—Side of the pharynx. A.—Elevates and dilates the pharynx. N.—Glosso-pharyngeal or 9th.

4.—*Hyo-pharyngeus.*—O.—Heel process, hyoid. I.—Median raphé. A.—Constricts the pharynx. N.—Pharyngeal plexus.

5.—*Thyro-pharyngeus.*—O.—Thyroid cartilage, larynx. I.—Median raphé. A.—Constricts the pharynx. N.—Pharyngeal plexus.

6.—*Crico-pharyngeus.*—O.—Cricoid cartilage, larynx. I.—Median raphé. A.—Constricts the pharynx. N.—Pharyngeal plexus and Superior laryngeal nerve.

7.—*Aryteno-pharyngeus.*—O.—Arytenoid cartilage, larynx. I.—Origin of the œsophagus. A.—Raises (brings forward) the œsophagus to admit the bolus. N.—Pharyngeal plexus.

G. Laryngeal Group.

EXTRINSIC MUSCLES.

1.—*Sterno-thyro-hyoideus.*—O.—Superior part of cariniform cartilage, sternum. I.—By two tendons,—thyroid cartilage; and

hyoid body and spur process. A.—Depresses the hyoid bone, larynx, and base of the tongue. N.—Inferior branch of first cervical nerve. R.—The trachea superiorly.

2.—*Hyo-thyroideus.*—O.—Heel process, hyoid. I.—Wing, thyroid cartilage. A.—Elevates the larynx or depresses the hyoid bone. N.—Hypoglossal or 12th, and inferior branch of 1st Cervical.

3.—*Hyo-epiglottideus.*—O.—Middle of the hyoid body. I.—Antero-inferior surface of the epiglottis. A.—Draws the epiglottis forwards and thus opens the larynx after the act of deglutition. N.—Inferior branch of the 1st Cervical.

INTRINSIC MUSCLES.

4.—*Crico-thyroideus.*—O.—Side of Cricoid cartilage. I.—posterior border of thyroid cartilage. A.—Tenses and elongates the vocal cords by drawing down the thyroid cartilage over the cricoid. N.—Superior laryngeal (of 10th.)

5.—*Crico-arytenoideus posticus.*—O.—Cricoid bezel. I.—Posterior tubercle, arytenoid cartilage. A.—By rotating outwards the arytenoid cartilage, separates the vocal cords and dilates the glottis. N.—Inferior or Recurrent laryngeal (of 10th).

6.—*Crico-arytenoideus lateralis.*—O.—Supero-lateral part of cricoid cartilage. I.—Outer tubercle at the base of arytenoid cartilage. A.—By rotating the arytenoid cartilage inwards, approximates the vocal cords and contracts the glottis. N.—Inferior laryngeal.

7.—*Thyro-arytenoideus.*—O.—Inner surface of the angle of the thyroid cartilage and crico-thyroid membrane. I.—Junction of arytenoid cartilages. A.—Shortens and relaxes the vocal cords by drawing the arytenoid cartilages with the cricoid forwards towards the thyroid. N.—Inferior laryngeal. R.—The superior vocal cord internally.

8.—*Arytenoideus.*—O.—Postero-external part of one arytenoid cartilage. I.—That of other arytenoid cartilage. A.—Constricts the glottis by approximating the arytenoid cartilages. N.—Inferior and superior laryngeal nerves.

H. Palpebral Group.

1.—*Orbicularis palpebrarum.*—O.—Lachrymal tubercle. I.—Orbital rim and the skin of both lids. A.—Closes the eyelids. N.—Anterior auricular of the 7th nerve.

2.—*Lachrymalis.*—O.—External surface of lachrymal and malar bones. I.—Buccinator fascia. A.—Corrugates the skin of the lower eyelid. N.—7th or Facial.

3.—*Levator palpebræ superioris externus* or Corrugator Supercilii.—O.—External orbital process of frontal near the supra-orbital foramen. I.—Orbicularis palpebrarum near the inner canthus. A.—Corrugates the skin of the upper eyelid. N.—Anterior auricular of the 7th.

4.—*Levator palpebræ superioris internus.*—O.—Sphenoid, above optic foramen. I.—Upper eyelid and tarsal cartilage. A.—Raises the upper eyelid. N.—3rd nerve or Motor oculi. (It plays over the eyeball like a rope over a pulley).

I. Orbital Group.

1.—*Rectus Oculi posterior* or *Retractor oculi.*—O.—Sphenoid, around the optic foramen. I.—posterior part of the sclerotic. A.—Retracts the eye within the orbit and thus causes pressure on the orbital fat, which pushes the membrana nictitans in front of the eye. N.—3rd and 6th nerves. (It is most developed in Ruminants, which during their whole time of feeding have the head in a dependent position.

2, 3, 4, and 5.—*Superior—, Inferior—, External—, and Internal Recti.*—O.—Sphenoid, respective arcs of the optic foramen. I.—Respective sides of the anterior part of the sclerotic. A.—

Turn the eyeball either up, down, in, or outwards when acting singly. Carry it in a diagonal direction when acting doubly. Retract it when all act together. Some anatomists consider them as the chief agents in adjusting the sight at different distances, by compressing the globe, and so lengthening its antero-posterior diameter. N.—3rd except the external rectus which is supplied by the 6th or Abducentes.

6.—*Superior* (Great) *Oblique* or *Trochlearis*.—O.—Sphenoid, above inner margin of optic foramen. I.—Outer side of the sclerotic between the superior and external recti. A.—Elevates and rotates the eyeball inwards and upwards. N.—4th or Pathetici. (At the inner canthus it plays in a fibro-cartilaginous ring or pulley).

7.—*Inferior Oblique* (Lesser or small oblique).—O.—Lachrymal fossa. I.—The sclerotic between the inferior and external recti. A.—Depresses and rotates the eye outwards and downwards. N.—3rd. (Superior and inferior oblique are brought into action for the correct viewing of an object, when the head is moved laterally, in order that the picture may fall in all respects on the same part of the retina of each eye).

8.—*Supernumerary* (Middle or 3rd) *Oblique*.—O.—Depression in the upper part of frontal orbital process. I.—Tendon of insertion of the superior oblique. A.—Regulates and facilitates the gliding of the superior oblique through the acute angle formed by its pulley. N.—4th, and frontal (supra-orbital) branch of the ophthalmic of the 5th.

J. External Auricular Group.

EXTRINSIC MUSCLES :—

1.—*Attollens Maximus*.—O.—Parietal crest. I.—Scutiform and conchal cartilages. A.—Adducts and erects the ear and turns its opening forwards. N.—Anterior auricular of the 7th.

2.—*Attolens anticus.*—O.—Squamosal, zygomatic crest. I.—Scutiform and conchal cartilages. A.—Draws the ear forwards. N.—Anterior auricular of the 7th. R.—The Parotid gland posteriorly.

3.—*Attolens posticus.*—O.—Parietal crest. I.—Conchal cartilage. A.—Erects and adducts the ear. N.—Anterior auricular of the 7th.

4, 5, and 6.—*Retrahens Externus,—Medius*, and—*internus.*—O.—The poll and the cordiform portion of the ligamentum nuchæ. I.—Posterior surface, outer side, and inner aspect of base of conchal cartilage, *respectively*. A.—Rotates the ear backwards and outwards, turning its opening backwards. N.—Posterior auricular of the 7th and superior branch of the 1st and inferior branch of the 2nd spinal (cervical) nerves.

7.—*Mastoido-Auricularis.*—O.—External auditory meatus. I.—Base of the concha. A.—Draws the concha downwards on the annular cartilage and thus shortens the external ear. N.—Middle auricular of the 7th.

8.—*Abducens.*—O.—External surface of the parotid gland. I.—Base of the concha. A.—Abducts and lowers the ear. N.—Cervical branch of the 7th and inferior branch of the 2nd cervical.

Intrinsic Muscles :—

9 and 10.—*Scuto-auricularis externus and internus.*—O.—Outer and inner surfaces of scutiform cartilage. I.—Inner and posterior parts of the concha. A.—Turns the opening forwards and inwards, and outwards and backwards, respectively. N.—Middle auricular of the 7th.

K. Middle Auricular (tympanic) Group.

1.—*Stapedius.*—O.—Interior of the pyramid. I.—Neck of the stapes. A.—Regulates the movements of the stapes. N.—Lesser superficial petrosal of the 7th.

2.—*Tensor tympani.*—O.—Petrosal bone near the Eustachian orifice and cartilaginous portion of the Eustachian tube. I.—Handle of the malleus. A.—Draws the membrana tympani inwards and thus heightens its tension. N.—Filament from the Otic ganglion (5th).

3.—*Laxator tympani.*—O.—Póstero-external angle of the Sphenoid wing. I.—Neck of the malleus. (It passes through the Glaserian fissure). A.—Draws the malleus and with it the tympanum outwards and thus relaxes it. N.—Lesser superficial petrosal of the 7th.

III. Trunk Region.

A. Inferior Cervical or Trachelian Group.

1.—*Sterno-maxillaris :*—O.—Anterior part of cariniform cartilage of sternum. I.—Angle of lower jaw. A.—With its fellow, flexes the head; Singly, turns it to one side. N.—The 11th or Spinal accessory & inferior branch of 1st cervical. R.—The Parotid gland externally; the trachea, carotid artery and sub-maxillary gland internally; and the jugular vein superiorly between it and the levator humeri.

2.—*Sterno-thyro-hyoideus :*—O.—Superior part of cariniform cartilage. I.—Thyroid cartilage (by one tendon) and hyoid spur process (by the other). A.—Depresses the hyoid bone and larynx with the base of the tongue. N.—Inferior branch of 1st cervical. R.—The trachea superiorly.

3.—*Subscapulc-hyoideus :*—O.—Subscapular fascia. I.—hyoid spur process. A.—Depresses the hyoid bone. N.—Inf. branch, 1st cervical. R.—The trachea, thyroid gland and carotid sheath (with its contents the carotid artery and pneumogastric, cervical portion of the sympathetic, and recurrent nerves) internally; the jugular vein, externally. It is distinctly separated by the muscle from the carotid artery in the anterior half of the neck.

4.—*Rectus capitis anticus major* :—O.—Transverse processes of the 3rd, 4th and 5th cervical vertebræ. I.—Occipital basilar process and body of sphenoid. A.—With its fellow, flexes the head ; singly, carries it to one side. N.—cervical nerves. R.—The common carotid artery, pneumogastric, cervical portion of sympathetic and recurrent nerves, and gutteral pouch, anteriorly ; the occipito-atloid joint posteriorly (superiorly).

5.—*Rectus capitis anticus minor* :—O.—Body of atlas, lower surface. I.—Occipital basilar process and body of sphenoid. A.—flexes the occipito-atloid joint and thus nods the head. N.—cervical nerves. R.—Gutteral pouch anteriorly ; occipito-atloid joint posteriorly.

6.—*Rectus capitis lateralis* :—O.—Atlas, lower surface, (outside the rectus minor). I.—Occipital styloid process. A.—Assists the major and minor. N.—Cervical nerves.

7.—*Scalenus* :—Consists of a superior or posterior, and an inferior or anterior portion. O.—Transverse processes of last 4 cervical vertebræ. I.—Superior part of, and anterior border and outer surface of, the 1st rib, respectively. A.—When the 1st rib is fixed, with its fellow it flexes the neck ; singly, turns it to one side. When the neck is fixed, it draws the 1st rib forwards and thus aids the inspiratory action of external intercostals. N.—Cervical nerves. R.—The trachea and common carotid artery with its accompanying nerves, and—on the left side only—the œsophagus, internally ; the jugular vein inferiorly ; and between its two portions, the nerves of the brachial plexus.

8.—*Longus Colli* :—O.—Inferior surface of bodies of 1st six dorsal, and inferior spines and transverse processes of 6 posterior cervical vertebræ. I.—Inferior spine (tubercle) of the atlas. A.—Flexes the neck. N.—Cervical nerves. R.—The trachea, œsophagus, and large blood-vessels and nerves accompanying

them, and—with the dorsal portion only—the pleuræ and great sympathetic nerves, inferiorly; the vertebræ, superiorly.

B. Lateral (Superior) Cervical Group.

1.—*Levator humeri*:—O.—Posterior mastoid process and mastoid (occipital) ridge, (anterior or superficial portion); Wing of the atlas and transverse processes of 2nd, 3rd and 4th cervical vertebræ, (posterior or deep portion). I.—Scapular spine and outer lip or anterior crest of furrow of torsion (musculo-spiral groove) of the humerus, [below and above the deltoid (external) tuberosity respectively]. A.—Carries the fore-limb forwards, when the head is fixed; but when the limb is fixed, it bends the neck and head to one side, or depresses them with its fellow. N.—11th or Spinal accessory, Cervical and Circumflex (axillary) nerves. R.—The carotid artery and jugular vein inferiorly; the parotid gland anteriorly. At the lower part of the neck it becomes blended with the sternal band of the panniculus, thus indirectly attached to the sternum.

2.—*Trapezius Cervicalis*:—O.—Funicular portion of the ligamentum nuchæ. I.—Scapula, tubercle of spine, and the scapular fascia. A.—Elevates and draws the shoulder (scapula) forwards. N.—11th or Spinal accessory.

3.—*Rhomboideus longus*:—O.—Funicular portion of the ligamentum nuchæ as high as the axis. I.—Anterior part of inner surface of the scapular cartilage of prolongation. A.—Elevates and draws the shoulder (scapula) forwards. N.—6th Cervical.

4.—*Serratus magnus* (Cervical portion):—O.—Transverse processes of the five last cervical vertebræ. I.—Anterior triangular surface on the scapular ventral (inner) surface. A.—Carries the humeral angle of the scapula backwards by pulling its cervical angle forwards; when the shoulder (scapula) is fixed, it with its fellow elevates the neck, and, singly, turns it to one side. N.—6th and 7th cervical.

5.—*Splenius* :—O.—Funicular portion of the ligamentum nuchæ and the superior spines of the first 4 or 5 dorsal vertebræ. I.—Occipital (masteid) ridge, wing of the atlas, and transverse processes of 3rd to 5th cervical vertebræ. A.—Elevates the head and neck with its fellow ; singly, draws them to one side. N.—Cervical and dorsal nerves.

6.—*Trachelo-mastoideus* :—O.—Transverse processes of the first two dorsal and the articular (oblique) processes of the last 6 cervical vertebræ. I.—Mastoid ridge and process, and wing of atlas, (by two tendons), A.—Erects the head with its fellow ; singly, turns it to one side. N.—Cervical and dorsal nerves.

7.—*Complexus major* :—O.—Superior spines of 2nd to 4th and transverse processes of the first 6 or 7 dorsal vertebræ, and oblique (articular) processes of the last 6 cervical vertebræ. I.—Scabrous pit by the side of the occipital (cervical) tuberosity. A.—Elevates or turns the head to one side as it acts in concert or singly. N.—Cervical and dorsal nerves. R.—The superior cervical vessels pass through its divisions posteriorly.

8.—*Complexus Minor* :—O—Superior spine of the axis. I.—Occipital insertion of the complexus major. A.—Assists the major. N.—1st Cervical.

9.—*Rectus capitis posticus major* :—O.—Superior spine of the axis. I.—Occipital scabrous pit beneath the insertion of the complexus major. A.—Extends the head. N.—1st Cervical.

10.—*Rectus capitis posticus minor* :—O.—Supero-anterior part of the atlas. I.—Occipital scabrous pit beneath the insertion of the lastdescribed muscle. A.—Assists the preceding. N.—1st Cervical.

11.—*Obliquus capitis anticus* :—O—Anterior edge of the wing of the atlas. I.—Occipital (mastoid) ridge and styloid process. A.—Extends the head with its fellow ; singly, bends it laterally on the atlas. N.—2nd Cervical.

12.—*Obliquus capitis posticus* :—O.—Lateral surface of superior spine of the axis. I.—Superior surface of the wing and body of the atlas. A.—Rotates the atlas with the head on the odontoid process of the axis. N.—2nd Cervical.

13.—*Spinalis colli* :—O.—Oblique (articular) processes of the first dorsal and the last 5 cervical vertebræ. I.—Superior spines of 2nd to 7th cervical vertebræ. A.—Extends the neck with its fellow ; singly, curves it to one side. N.—Cervical nerves.

14.—*Intertransversalis colli*:—O.—Articular processes of the first dorsal and the last 5 cervical vertebræ. I.—Transverse processes of the last 6 cervical vertebræ. A.—Flexes the neck laterally. N.—Cervical nerves. R.—The vertebral vessels, spinal nerves, and intervertebral foramina internally. Branches of the vertebral vessels and spinal nerves perforate the muscle.

C. Costal Group.

1.—*Trapezius dorsalis* :—O.—Superior spines of 3rd to 10th or 11th dorsal vertebræ and their supraspinous ligament. I.—Scapula, tubercle of spine. A.—Draws the shoulder (scapula) upwards and backwards. N.—11th or Spinal Accessory.

2.—*Rhomboideus brevis* :—O.—Superior spines of the first 4 or 5 dorsal vertebræ and their supraspinous ligament. I.—Scapular cartilage of prolongation, inner surface (behind the longus). A.—Draws the shoulder upwards. N.—6th Cervical.

3.—*Latissimus dorsi* :—O.—Superior spines of 4th dorsal to last lumbar and their supraspinous ligament. I.—Humeral, shaft, internal tuberosity. A.—Carries the humerus upwards and backwards i. e. flexes it, and rotates it inwards ; when the limb is fixed, it acts as an inspiratory muscle. N.—Thoracic nerves from brachial plexus.

4.—*Serratus magnus* (costal portion) :—O.—External surface

of the 8 true (sternal) ribs. I.—Anterior and posterior triangular surfaces on the venter (inner surface) of the scapula between the origin of the subscapularis and the insertion of the rhomboidei. A.—Draws the superior border of the scapula downwards and backwards & thus carries its inferior angle with the shoulder-joint upwards and forwards; when the limbs are fixed, it with its fellow elevates the ribs forwards and thus acts as an inspiratory muscle. In the standing posture of the animal it with its fellow serves as a *muscular sling* or *girth*, in which the thorax is suspended between the fore-limbs. N.—Thoracic nerves from brachial plexus.

5.—*Superficialis costarum*:—O.—Superior spines of 2nd to 13th dorsal vertebræ and their supraspinous ligament, (anterior portion); Superior spines of 11th dorsal to 2nd lumbar vertebræ, (posterior portion.) I.—Anterior borders and outer surfaces (just below the angles) of nine ribs (5th to 13th), and posterior borders and outer surfaces of last nine ribs (9th to 18th), *respectively*. A.—Respectively draw the ribs outwards and forwards, and backwards and upwards, and thus act as an inspiratory, and an expiratory muscle. N.—Dorsal.

6.—*Transversalis Costarum*:—O.—Transverse processes of first 2 lumbar vertebræ, and the anterior borders of the ribs near their tubercles. I.—Posterior borders of all the ribs and the transverse process of 7th cervical vertebra, by separate tendons. A.—Draws the ribs backwards and compresses them, thus assisting in expiration; with its fellow extends the dorsal portion of the spine. N.—Dorsal.

7.—*Levatores costarum*:—O.—Transverse processes of dorsal vertebræ. I.—Outer surfaces of ribs (just above their angles) posterior to the vertebræ from which they take origin. A.—Elevate and draw the ribs forwards, thus acting as inspiratory muscles. N.—Dorsal.

8.—*Intercostales* :—Are external and internal and usually 17 in number.

EXTERNAL :—O.—Posterior border of each preceding rib (1st to 17th). I.—Anterior border of each succeeding rib (2nd to 18th). A.—Draw the ribs forwards, and thus act as inspiratory muscles, the first rib being fixed by the contraction of the scalenus. N.—Intercostals.

INTERNAL :—O.—Anterior border of each succeeding rib and costal cartilage (18th to 2nd.) I.—Posterior border of each preceding rib and costal cartilage (17th to 1st). A.—Intercartilaginous portions act as inspiratory muscles, and interosseous portions act as expiratory muscles. N.—Intercostals. R.—The external intercostal muscles externally, the costal pleura internally, and the intercostal vein, artery and nerve anteriorly.

D. Pectoral Group.

1.—*Pectoralis Transversus* :—O.—Inferior border of the first 4 sternebræ and median white fibrous cord. I.—Deltoid ridge of the humerus, and the olecranon process of the ulna (by superficial fascia of the fore-arm). A.—Adducts the arm and tenses the brachial fascia. N.—From brachial plexus. R.—The subcutaneous vein, the posterior radial vessels and the median nerve are covered by it at the elbow-joint.

2.—*Pectoralis magnus* :—O.—Abdominal tunic, ensiform cartilage, inferior border of the last 3 or 4 sternebræ, and tips of costal cartilages of the 5th to 8th ribs. I.—Inner and outer trochanters of the humerus, and the bicipital fascia. A.—Pulls the shoulder and limb backwards, and acts as an inspiratory muscle in difficult respiration and when the limb is fixed. N.—From brachial plexus (median and subcutaneous thoracic). R.—The spur (subcutaneous thoracic) vein borders its superior margin.

3.—*Pectoralis anticus* :—O.—Cariniform cartilage and the inferior border of the 1st sternebra. I.—Deltoid ridge of the humerus. A.—Adducts the arm. N.—From brachial plexus. R.—It, with the levator humeri anteriorly, forms a triangular space for the cephalic or *plat* vein.

4.—*Pectoralis parvus* :—O.—Cariniform cartilage, anterior 3 or 4 sternebræ, and cartilages of the first 4 ribs. I.—Scapular fascia covering the anteaspinatus muscle and the anterior border of the scapula. A.—Draws the scapula and limb backwards and downwards, and tenses the scapular fascia. N.—From brachial plexus.

E. Sternal Group.

1.—*Lateralis sterni* :—O.—Outer surface of the 1st rib. I.—Sternum at about the 4th sternebra. A.—Acts as an auxiliary muscle of expiration. N.—Intercostal.

2.—*Triangularis sterni* :—O.—Superior sternal ligament and superior (thoracic) surface of the sternum. I.—Inner surfaces of the costal cartilages and distal ends of the 2nd to 8th true (sternal) ribs. A.—Assists in expiration by pulling the cartilages and rib-ends inwards and backwards. N.—Intercostal. R.—The pleura, superiorly (internally); and the internal throacic vessels, inferiorly (externally).

F. Dorso-Lumbar Group.

1.—*Longissimus Dorsi* :—O.—Iliac crest, anterior iliac spine, and iliac venter (internal) surface; sacro-iliac ligament; spinous and transverse processes of the first two bones of the sacrum; and superior spines of all the lumbar and dorsal vertebræ and their supraspinous ligament. I.—Transverse and oblique (articular) processes of all the lumbar, and transverse processes of all the dorsal and last 4 cervical vertebræ; and the outer surface of the last 15 or 16 ribs, just above the transversalis costarum. A.—

Extends the dorso-lumbar portion of the spine, with its fellow; singly, bends it laterally; also assists in expiration by its costal attachments, and in kicking and rearing according to whether the fore or hind limbs are fixed. N.—Cervical, dorsal and lumbar.

2.—*Spinalis Dorsi*:—O.—Summits of the first 12 dorsal spines and their supraspinous ligament, and the posterior borders of the first 6 dorsal spines. I.—Superior spines of the last 3 or 4 cervical vertebræ. A.—Raises the neck. N.—Cervical and dorsal.

3.—*Semispinalis dorsi et lumborum*:—O.—Sacral lateral lips lumbar articular processes, and dorsal transverse processes. I.—Sacral, lumbar, and dorsal spines and that of the last cervical. A.—Extends or flexes the dorso-lumbar region of the spine to one side as it acts with its fellow or singly. N.—Dorsal and lumbar.

4.—*Intertransversales Lumborum*:—Are thin muscular slip, running from the anterior border of one lumbar transverse process to the posterior border of the other. A.—Flexes the lumbar portion of the spine laterally. N.—Lumbar.

G. Abdominal Group.

Consists of 4 pairs of muscles, covered externally by the *abdominal tunic*, and separated on the right from those on the left by the *linea alba*. Each of the muscles except the rectus consists of a fleshy and an aponeurotic portion, and the line of demarcation between them is called the *linea semilunaris*.

Tunica Abdominalis is a great expansion of yellow elastic fibrous tissue covering the external oblique muscles with which it is intimately adherent, and spread over the inferior and lateral walls of the abdomen. It is thickest posteriorly at the pubis (where it furnishes a few fibres which are detached from the surface of the common or prepubian tendon and are carried

between the thighs to be lost in the crural muscles) and on each side of the linea alba, and is thin near the sternum behind and beneath the pectoralis magnus, and over the fleshy portion of the external oblique. It by its external surface gives attachment to the suspensory ligaments of the sheath and to the dartos in the male, and to the elastic envelope which covers each mammary gland in the female. A.—By its great elasticity it assists the abdominal muscles in supporting the heavy weight of the abdominal viscera and adapts the abdominal wall to the varying volume of its contents.

Linea Alba (white line) is the white mesian fibrous cord between the recti-abdominales, attached anteriorly to the xiphoid or ensiform cartilage, and posteriorly confounded with the *prepubian* or *common abdominal tendon*, which is attached to the anterior border (crest) of the pubes, assists to form the internal commissure of the inguinal canals, and gives origin to the pubio-femoral ligament. Mid-way between its middle and posterior third is a puckered cicatrix-the *umbilicus*.

1.—*Obliquus Abdominis Externus* :—O.—Outer surface of the last 13 or 14 ribs, just below their middle, the fascia of the latissimus dorsi (behind the last rib), and lumbar fascia superiorly. I.—Linea alba, pubis and prepubian tendon, and anterior iliac spine and crest. A.—It, with its fellow, supports the abdominal viscera, flexes the spine (arches the back), assists in expiration by pulling the ribs backwards if the spine is fixed, and, when both the spine and ribs are fixed, compresses the abdominal viscera, thus aiding in vomiting, micturition, defæcation, and parturition; singly, it bends the trunk or pelvis laterally. N.—Last ten intercostal, last dorsal and first 2 lumbar.

Aponeurosis of the obliquus externus is posteriorly divisible into 2 layers. One of which descends on the inner side of the thigh from the fold of the groin to the patella, and inner side of

the leg to form the *Crural aponeurosis* which covers the cr vessels and the sartorius, (part of) gracilis, and vastus internus; and the other is reflected upwards and forwards to enter the abdominal cavity, and constitutes the *Crural arch* or *Poupart's* (Fallopius') *ligament*. The aponeurosis is pierced near the prepubian tendon by a large oval slit, the *external abdominal ring*.

Poupart's ligament or *crural arch* is a ribbon-shaped reflected layer of the external oblique aponeurosis extending from the anterior iliac spine to the pubic crest and separating the trunk from the hind limb. It is concave *anteriorly*, and forms the posterior wall of the inguinal canal internally, and gives attachment to the internal oblique muscle externally; *posteriorly* it is convex, and comes in contact with, and forms an arch over the crural (external iliac) vessels and nerve, and the sartorius and pectineus muscles. *Superiorly* it is attached to the lumbo-iliac aponeurosis for its exteral half, is blended with the outer surface of the sartorius and iliacus in its middle part, and internally, inside the pectineal insertion of the psoas parvus, forms with the pubic crest, the iliacus, and sartorius a triangular aperture, the *crural ring* for the crural vessels. *Inferiorly* it is continuous with the crural and external oblique aponeuroses.

Inguinal Canal is a funnel-shaped passage, 2 to 2½ inches long, in the abdominal wall, running obliquely downwards, backwards and inwards, between the crural arch posteriorly and the internal oblique muscle anteriorly. Through it descends the testis in the young animal, and pass the external pudic vessels and inguinal nerves, and the spermatic cord with the cremaster muscle and dorsal vessels of the penis in the male, and round ligament and mammary vessels in the female. Its external opening is called the *external* (inferior) *abdominal ring*, or *cutaneous orifice*, and

is oval and larger than its internal orifice, which is called the *internal* (superior) *abdominal ring* or *peritoneal orifice.*

2.—*Obliquus abdominis internus* :—O.—Anterior iliac spine and external fourth of the Poupart's ligament, and first 2 or 3 lumbar transverse processes. I.—Pubic crest by prepubian tendon, linea alba, last 4 or 5 asternal cartilages, and posterior border of the last rib. A. and N.—*Idem* of external oblique. (A portion of this muscle, which arises from the first 2 or 3 lumbar transverse processes and is inserted into the posterior border of the last rib is called the RETRACTOR COSTÆ. A.—Assists in expiration by drawing the last rib backwards. N.—Last dorsal and 1st lumbar.)

3.—*Rectus abdominis* :—O.—Lower surface of the ensiform cartilage and sternum, and 5th to 9th costal cartilages. I.—Pubic crest by the prepubian tendon. A and N.—*Idem* of oblique. It also assists copulation by drawing the pelvis forwards. (Its transverse tendinous intersections are called the *lineæ transversæ* or *inscriptiones tendineæ.*

4.—*Transversalis abdominis* :—O.—All lumbar transverse processes, and inner surfaces of last 10 asternal cartilages. I—Ensiform cartilage, linea alba, and outer third of poupart's ligament. A. and N.—*Idem* of Oblique. R.—The peritoneum with the intervening thin *fascia transversalis* and branches of intercostal vessels, internally ; and the diaphragm, anteriorly.

H —Sublumbar Group.

The muscles of this group are covered by the iliac fascia.

1.—*Psoas Magnus* :—O.—Inferior (inner) surfaces of the last 2 ribs, the bodies of the last 2 dorsal and first 5 lumbar vertebræ, and the lumbar transverse processes. I.—Trochanter minor internus of the femur. A.—Flexes and rotates the thigh outwards ; also flexes (arches) the loins when the hind limbs are

fixed. N.—Lumbar. R.—The iliac fascia, peritoneum, kidney, renal vessels, ureter, spermatic vessels colon, diaphragm, and pleura inferiorly.

2.—*Psoas Parvus* :—O.—Bodies of the last 3 or 4 dorsal and all lumbar vertebræ. I.—Ilio-pectineal eminence and the iliac fascia. A.—Flexes the pelvis on the spine or arches (flexes) the loins according as the loins or the pelvis are fixed ; also tenses the iliac fascia. N.—Lumbar. R.—The pleura, diaphragm, posterior aorta and vena cava, and great sympathetic nerve inferiorly.

3.—*Iliacus* :—O.—Ilio-pectineal line, entire iliac venter (inner) surface, inferior sacro-iliac ligament, and anterior iliac spine. I.—Trochanter minor internus (femur), by a common tendon with the psoas magnus. A.—*Idem* of psoas magnus. N.—Lumbar. R.—The crural vessels internally.

4.—*Quadratus lumborum* :—O.—Inferior sacro-iliac ligament. I.—Tips of lumbar transverse processes, posterior border of the last rib, and inner surfaces of the last 2 or 3 ribs close to the spine. A.—Assists the diaphragm in forced expiration by drawing the last rib backwards and fixing it ; also bends the loins laterally. N.—Lumbar.

I. Diaphragmatic Group.

1.—*Diaphragm* or *Midrif* is a heart-shaped musculo-aponeurotic septum placed obliquely downwards and forwards between the thoracic and abdominal cavities. It is wider above than below, convex anteriorly and concave posteriorly, and consists of a peripheral (circumferential) fleshy portion, a central aponeurotic (tendinous) portion (the *phrenic centre*), and 2 muscular pillars or *Crura.*

(a).—The *peripheral fleshy portion* or *Muscular Rim* :—O.—Inner surface of the inferior ends of the last 12 ribs or their

cartilages, and the superior surface of the ensiform cartilage. I.—Phrenic centre.

(b).—The *aponeurotic (tendinous) Centre, Phrenic Centre* or *Speculum Helmontii* :—O.—Crura. I.—Fleshy portion. It is incompletely divided into right and left halves or leaflets (folioles) by the descent of the crura from the sublumbar region, and consists of pearly white glistening fibres intersecting in every direction. In its right leaflet is the *foramen dextrum.*

(c).—The *Crura* or *Pillars of the diaphragm* are right (longer and larger) and left, the right being pierced by the *foramen sinistrum* and partly separated from the left by the *hiatus aorticus.* The right arises from the under surface of the first 5 lumbar bodies and their inferior common vertebral ligament, and the left from only first 1 or 2 lumbar bodies, and they both are inserted into the phrenic centre.

(d).—*Ligamenta Arcuata* are tendinous arches, one on each side of the pillars, formed by the peripheral fleshy portion for the passage of the psoe muscles and the sympathetic and splanchnic nerves.

(e).—*Foramina of the diaphragm* are 3 in number and are from below upwards :—(1) the *foramen dextrum* for the posterior vena cava, (2) the *foramen sinistrum* for the œsophagus, pneumogastric nerves and pleural artery, and (3) the *Hiatus Aorticus* for the posterior aorta, vena azygos major and thoracic duct.

Action.—The diaphragm is an essential muscle of inspiration. By its contraction it becomes flattened, pushes the abdominal viscera backwards and thus enlarges the thoracic cavity in its antero-posterior diameter. It also assists the abdominal muscles in expulsive efforts of sneezing, coughing, vomiting, defecation, micturition and parturition. N—Phrenic nerves. R.—The pleura, pericardium, lungs and heart anteriorly ; the peritoneum, liver, stomach, spleen and large colon posteriorly.

J.—Coccygeal Group.

1.—*Erector coccygis* :—O.—Summits and sides of the last 3 or or 4 super-sacral spines and the coccygeal vertebræ. I.—Superior surface of the coccygeal vertebræ by separate tendons. A.—Directly elevates the tail, with its fellow ; singly, draws it upwards and outwards. N.—Coccygeal.

2.—*Depressor coccygis* :—O.—Posterior half of the inferior surface of the sacrum, inner surface of the sacro-sciatic ligament and the coccygeal vertebræ. I.—Inferior surface of the coccygeal vertebræ by seperate tendons. A.—Directly depresses the tail downwards, with its fellow ; singly, draws it downwards and outwards. N.—Coccygeal. R.—The rectum inferiorly ; the sacro-sciatic ligament externally.

3.—*Curvator coccygis* :—O.—Last two lumbar spines, and sides of the sacral and coccygeal bones. I.—Side of the coccygeal bones. A.—Draws the tail laterally. N.—Coccygeal.

4.—*Compressor coccygis* :—O.—Superior ischiatic spine and inner surface of the sacro-sciatic ligament. I.—Side of the last sacral and first 2 coccygeal vertebræ. A.—Depresses the entire tail. N.—Coccygeal. R.—The sacro-sciatic ligament externally ; the rectum internally.

K.—Perineal Group.

A.—Muscles of the male perineum :—

1.—*Sphincter Ani* :—O.— Root of the tail. I.—Perineal fascia. A.—Keeps the anus closed except during defæcation. N.—Hæmorrhoidal of the 5th sacral, and internal pudic.

2.—*Levator ani* :—O.—Under surface of the anterior coccygeal bones. I.—Sphincter ani (superiorly). A.—Elevates the anus. N.—Hæmorrhoidal.

3.—*Retractor ani* :—O.—Superior ischiatic spine and inner

surface of the sacro-sciatic ligament. I.—Sphincter ani (laterally). A.—Retracts the anus after defæcation. N.—Hæmorrhoidal.

4.—*Cremaster* or Tunica erythroides :—O.—Iliac fascia covering the psoe muscles. I.—Infundibuliform fascia (innermost fibrous tunic) of the scrotum, after passing through the inguinal canal on the outer side of the spermatic cord. A.—Suspends and raises the testicle. N.—3rd lumbar.

5.—*Accelerator Urinæ* :—O.—Ischial arch and median fibrous raphe along the under surface of the urethra (penis). I.—Upper surface of the urethra. (It with its fellow almost encircles the entire urethra as far forwards as the glans penis.) A.—Ejects the semen and urine (at the close of micturition) by diminishing the urethral calibre. N.—Internal pudic.

6.—*Erector penis.*—O.—Inferior ischiatic spine. I.—Crus of the penis A.—Erects the penis. N.—Internal pudic.

7.—*Retractor penis.* :—O.—Inferior surface of the sacrum. I.—Accelerator urinæ as far forwards as the glans penis. (It with its fellow forms a suspensory ring for the rectum). A.—Retracts the penis within the sheath (prepuce). N.—Internal pudic.

8.—*Wilson's muscle* :—O.—Lateral walls of the pelvis. I.—Membranous urethra, embracing Cowper's glands. A.—Compresses the glands and the membranous urethra, thus assisting the discharge of glands, urine, and semen, and preventing the semen regurgitating into the bladder. N.—Internal pudic.

Ischio-urethral (Compressor urethræ) :—O.—Ischial arch I.—Membranous urethra, beneath Cowper's gland. A.—Aids Wilson's muscle. N.—Internal pudic. (Strangeways includes it with Wilson's).

Transversus Perinæi (sometimes absent) :—O.—Ischial tuberosity, behind the erector penis. I.—Central line of the perineum

and the accelerator urinæ at its origin. A.—Dilates the bulbous urethra. N.—Internal pudic. (It is confounded with the retractor ani.)

B.—MUSCLES OF THE FEMALE PERINÆUM.

1, 2 & 3—*Sphincter—, levator—, and Retractor ani:—Idem* as in the male.

4.—*Erector clitoridis* (analogous to erector penis):—O.—Ischial arch. I.—Crus of the clitoris. A.—Erects the clitoris. N.—Internal pudic.

5.—*Constrictor Vulvæ Anterior* (analogous to Wilson's muscle):—O.—Sides of the rectum. I.—Sides and under surface of the vagina at its entrance. A.—Constricts the vagina. N.—Internal pudic.

6.—*Constrictor Vulvæ Posterior* (analogous to accelerator urinæ):—O.—Sphincter ani and sacral under surface through the suspensory ligaments. I.—Base of the clitoris and inner surface of the skin below the inferior commissure of the vulva. A.—Constricts the orifice of the vulva, and erects the clitoris. N.—Internal pudic.

7.—*Suspensory ligament* (analogous to retractor penis):—O.—Under surface of the sacrum. I.—Labia of the vulva and constrictor vulvæ posterior, after first becoming united with its fellow beneath the rectum to form its suspensory ring. A.—Suspends the vagina. N.—Internal pudic.

IV. Pectoral Limb Region.

A.—External Scapular Group.

1.—*Teres Externus*:—O.—Posterior (dorsal) angle and border of the scapula, (posterior portion); tubercle on the scapular spine, (anterior portion). I.—External (deltoid) tuberosity of the humerus. A.—Abducts the humerus and rotates it outwards; flexes

the shoulder joint with the teres internus. N.—Circumflex or Axillary.

2.—*Antea-spinatus* :—O.—Antea-spinatus fossa and anterior (cervical) angle and border of the scapula and that of its spine. I.—Summits of the external and internal trochanters of the humerus (by 2 tendons). A.—Extends the humerus and tenses the flexor brachii fascia. N.—Anterior scapular. (At its insertion it divides for the passage of the flexor brachii tendon).

3.—*Postea-spinatus* :—O.—Postea-spinatus fossa, and posterior border of the scapular and that of its spine, and cartilage of prolongment. I.—Humerus, convexity of external trochanter, and ridge below it (by 2 tendons). A.—Abducts and rotates the humerus outwards. N.—Anterior scapular. R.—The capsular ligament of the shoulder-joint, inferiorly. (Between its outer tendon of insertion and convexity of external trochanter there is a synovial bursa).

4.—*Postea-spinatus minor* :—O.—Posterior border, lower part of postea-spinatus fossa and external tubercle on the glenoid rim of the scapula. I.—Deltoid ridge (upper third). A.—Abducts and rotates the humerus outwards. N.—Circumflex. R.—The Capsular ligament, internally.

B.—Internal Scapular Group.

1.—*Subscapularis* :—O.—Subscapular fossa (venter surface). I.—Internal humeral trochanter, a small synovial bursa intervening. A.—Adducts and slightly rotates the humerus inwards. N.—Subscapular. R.—The antea spinatus *anteriorly*, and between them pass the prescapular vessels and anterior (supra) scapular nerve ; the teres internus *posteriorly* and between them pass the subscapular vessels and nerve ; and the capsular ligament *externally*. (Its tendon of insertion is crossed by the tendon of origin of the flexor brachii which glides over it by means of a synovial bursa).

2.—*Teres Internus* :—O.—Posterior (dorsal) angle and border of the scapula. I.—Humeral internal tuberosity. A.—Adducts and rotates the arm inwards ; it, with the teres externus, flexes the arm. N.—From brachial plexus.

3.—*Scapulo-humeralis posticus* :—O.—Scapula, just above and behind the glenoid rim. I.—Capsular ligament of the shoulder-joint and extreme postero-superior part of the humeral shaft. A.—Raises and tenses the capsular ligament of the shoulder-joint during flexion and thus prevents its injury. N.—Circumflex. (This muscle is peculiar to Solipeds).

C.—Anterior Brachial Group.

1.—*Flexor Brachii* :—O.—Base of the coracoid process of the scapula. I.—Bicipital or Supero-internal tuberosity of the radius, capsular ligament of the elbow-joint, sheath of the extensor metacarpi magnus, and the fascia (antibrachial) of the forearm. A.—Flexes the forearm on the arm, extends the arm on the scapula, and tenses the antibrachial fascia. The central resisting tendinous (fibrous) cord acts as a ligament, a mechanical support, and an extensor of the shoulder joint, when the animal is standing and the forearm is extended by the triceps extensor brachii. N.—Median or its anterior root. [The muscle is divided by several fibrous (tendinous) intersections one of which, the central resisting tendinous cord, traverses the muscle in its entire length. The tendon of origin of this muscle is fibro-cartilaginous and glides over the humeral bicipital groove by means of a synovial bursa.]

2.—*Coraco-humeralis* :—O.—Beak of the scapular coracoid process. I.—Humeral shaft, by 2 insertions ; one (deep) just above, and the other (superficial) below and anteriorly to the internal tuberosity. A.—Adducts and rotates the arm inwards. N.—Median. R.—The Humeral (brachial) vessels, the median and ulnar nerves posteriorly ; the prehumeral (anterior circum-

flex) vessels and the nerve to this muscle and the biceps pass between its 2 insertions.

3.—*Humeralis Obliquus* (lodged in the musculo-spiral groove or the furrow of torsion.) :—O.—Postero-superior part of the humeral shaft, below its articular head. I.—Inner side of the superior extremities of the radius and ulna, and the arciform (superior radiating) ligament which joins these bones. A.—Flexes the elbow joint. N.—Musculo-cutaneous or antibrachial.

D.—Posterior Brachial Group.

1.—*Scapulo-ulnaris* :—O.—Posterior (dorsal) angle and border of the scapula. I.—Inner side of the olecranon beak and the antibrachial fascia (of forearm). A.—Extends the forearm and tenses the antibrachial fascia. N.—Radial or musculo-spiral. R.—It covers the ulnar vessels and nerve near its insertion.

2.—*Triceps Extensor Brachii* :—O —Posterior (dorsal) angle and border of the scapula (Caput magnum) ; humeral shaft, the curved upper third of the deltoid ridge (caput medium) ; humeral shaft, below and behind the internal tuberosity (caput parvum) I.—Olecranon process of the ulna. (A synovial bursa is interposed between the olecranon summit and the caput magnum tendon). A.—Extends the forearm ; the caput magnum also flexes the shoulder-joint. N.—Radial. R.—The ulnar vessels and nerve internally.

3.—*Anconeus* :—O.—Margins of the olecranon fossa and the capsular ligament of the elbow joint. I.—Antero-external part of the olecranon. A.—Assists extension of the elbow and raises the capsular ligament to prevent its injury during extreme extension. N.—Radial.

E.—Anterior Antibrachial Group.

1.—*Extensor Metacarpi Magnus* :—O.—Epitrochlea of the humerus, capsular ligament of the elbow joint anteriorly, and the

humeral surface just above (in common with the extensor pedis). I.—Antero-internal tuberosity on the cannon-head. A.—Extends the carpus and the metacarpus on the forearm. N.—Radial. R.—Its inferior tendon passes through the most internal vertical groove on the radial inferior extremity in a synovial sheath, and over the capsular ligament of the knee-joint through a second synovial sheath. It is crossed above the knee by the extensor metacarpi obliquus tendon, and is bound down to the knee-joint capsule by the anterior annular ligaments.

2.—*Extensor metacarpi obliquus*:—O.—Radial inner border (surface). I.—Inner splint head. A.—Extends and slightly rotates, from within forwards, the metacarpus. N.—Radial. R.—Its inferior tendon glides through an antero-internal oblique (middle) groove on the radial inferior extremity by means of a synovial sheath, and crosses the magnus tendon.

3.—*Extensor pedis* :—O.—Base of the humeral epitrochlea, front of the humeral inferior extremity (in common with the extensor metacarpi magnus), anterior border of the external lateral ligament of the elbow joint, and the radial supero-external tuberosity. I.—(by 2 tendons).—Extensor Suffraginis tendon—(short tendon); Pyramidal process of the os pedis, after being attached to the capsular ligament of the fetlock-joint to the anterior surfaces of the 1st and 2nd phalanges—(long tendon). A.—Extends the phalanges on each other successively from 3rd to 1st and the entire foot on the fore-arm. N.—Radial. R.—Its tendon with that of Phillips' muscle glides through the antero-external groove on the radial inferior extremity by means of a synovial sheath; between it and the capsular ligament of the fetlock joint there is a small synovial bursa, and below the fetlock it meets with the two bifurcations of the suspensory ligament (one on each side). The extensor suffraginis, the radius, carpus, metacarpus and phalanges *posteriorly*; the extensor metacarpi magnus, *internally*.

Two small muscles on the postero-external side of the extensor pedis have been named Phillips' and Thiernesse's muscles from their discoverers. They are considered as parts of the extensor pedis.

(a).—*Phillips' muscle* :—O.—External lateral ligament of the elbow-joint and the radial supero-external tuberosity. I.—Extensor suffraginis tendon, about the fetlock.

(b).—*Thiernesse's muscle* :—O.—External arciform ligament of the radio-ulnar joint. I.—Extensor pedis tendon, a little above the carpus. (It lies on the inner side of Phillips'.)

4.—*Extensor Suffraginis.*—O.—Radial supero-external tuberosity, external lateral ligament of the elbow-joint, and external aspects of the radial and ulnar shafts. I.—Capsular ligament of the fetlock-joint and front of the head of the 1st phalanx (os suffraginis). A.—Extends the digit and also the entire foot on the forearm. N.—Radial. R.—Its tendon passes through a vertical groove on the outer side of the radial inferior extremity, and down the outer side of the carpus through a synovial sheath to reach the anterior surface of the cannon bone, and glides over the anterior (capsular) ligament of the fetlock joint by means of a synovial bursa. Below the knee it receives a tendinous slip from the extensor pedis tendon and a strong fibrous (ligamentous) slip from the trapezium. The extensor pedis *anteriorly*, and the flexor metacarpi externus and the flexor pedis perforatus and perforans *posteriorly*.

F.—Posterior Antibrachial Group.

1.—*Flexor Metacarpi Externus* :—O.—Humerus, summit of the epitrochlea. I.—(by 2 tendons)—Upper border of the trapezium—(posterior tendon); head of the outer splintbone, after passing in a synovial sheath through the oblique groove on the outer surface of the trapezium—(anterior tendon). A.—Flexes the carpus and the foot on the forearm. N.—Radial.

2.—*Flexor Metacarpi Medius*:—O.—(by 2 heads)—Humerus, base of the epicondyle-(large or anterior head); Ulna, posterior border of the olecranon process-(small or posterior head). I.—(by a single tendon)—Upper border of the trapezium, blending with the posterior tendon of the flexor metacarpi externus. A.—Flexes the carpus. N.—Ulnar or Cubital. R.—The Ulnar vessels and nerve pass beneath its small or posterior head.

3.—*Flexor Metacarpi Internus*:—O.—Humerus, base of the epicondyle, blending with the humeral origin of the middle flexor. I.—Head of the inner splint bone, after passing through a synovial sheath on the inner side of the carpus. A.—Flexes the carpus and the foot on the forearm. N.—Median. R.—The posterior radial vessels and the median nerve lie between the muscle and the postero-internal side of the radius.

4.—*Flexor pedis perforatus*:—O.—Humerus, summit of the epicondyle (in common with the perforans tendon). I. Supero-postero-lateral aspects of the os coronæ (by a bifid tendon). A.—Flexes the pastern, fetlock, and carpal joints, and, through its superior check ligament acts as a mechanical support to the joints below when the animal is standing. N.—Ulnar and Median. R.—Its tendon begins a little above the carpus where it is reinforced by a broad fibrous band—the Superior Carpal or *superior check* ligament—which arises from the postero-inferior part of the radius, and is also intimately attached to the antibrachial fascia and the perforans muscle. After being thus reinforced its tendon passes through the CARPAL SHEATH in company with the perforans tendon anteriorly, and below the knee assists in the formation of a synovial sheath for the perforans tendon. Behind the fetlock it expands and forms a ring through which passes out the perforans tendon, and hence they are termed *Perforatus* and *Perforans*. Here they both pass through the METACARPO-PHALANGEAL SHEATH and just below the pastern joint the peforatus tendon bifurcates to be ulti-

mately attached to the supero-lateral aspects of the os coronæ.

The perforatus and perforans tendons are also supplied by the metacarpal and posterior digital nerves.

The CARPAL SHEATH is the ring or canal for the passage of the flexors of the digit, formed by the external (posterior) surface of the common posterior ligament of the carpus *in front*, and the annular ligament—a thick inelastic white fibrous expansion extending from the trapezium to the inner side of the carpus—*behind*. It is lined by a synovial membrane, which envelopes the perforans and perforatus tendons in this canal, and extends upwards for 2 or 3 inches above the carpus, and downwards as far as the lower third of the metacarpus.

The METACARPO—PHALANGEAL or GREAT SESAMIOD SHEATH is the second canal through which pass the flexors of the digit. It is formed by the sesamoid groove with the intersamoidean ligament and the pad of fibro-cartilage covering it, the porterior surface of the inferior navicular ligaments and of the glenoidal fibro-cartilage of the pastern joint, and the supero-posterior gliding surface of the os coronæ *in front*, and the annular ligament—a strong fibrous expansion extending posteriorly like an arch from one sesamoid to the other—*behind*, which is closely adherent to the perforatus tendon and is laterally attached, by 3 special fiberous slips on each side, to the sesamoids and the 1st and 2nd phalanges. A very large synovial membrane lines this canal, envelopes the flexor tendons, and projects upwards upto the buttons of the splint bones and downwards as far as the middle of the os coronæ, forming 2 *culs-de-sac*-a small or upper, and a large or lower which meets, behind the os coronæ, the superior *cul-de-sac* of the navicular sheath, and also the *cul-de-sac* of the synovial membrane of the coffin-joint.

5.—*Flexor pedis perforans* :—O.—Humeral epicondyle, in common with the perforatus. I.—Semilunar ridge and the triangular roughened depression behind it on the inferior surface (sole)

of the os pedis, blending laterally with the lateral fibro-cartilages. A.—Flexes the coffin, pastern, fetlock and carpal joints succesively from below upwards, and, through its inferior check ligament and its strengthening (reinforcing) sheath, acts as a mechanical support to the fetlock, pastern, and coffin joints when the animal is standing. N.—Median. R.—Its inferior tendon begins a little above the carpus where it joins with the *Ulnaris* and *Radialis Accessori* teudons. The united tendon passes through theposterior CARPAL SHEATH in company with the perforatus tendon posteriorly, and the metacarpal vessels and nerve internally. About the middle of the metacarpus it is reinforced by a strong fibrous band—the Inferior Carpal or *Inferior check* ligament—from the suspensory ligament. (It is this inferior check ligament which is often involved in "Sprain of the back sinews"). After being thus reinforced the united tendon passes down between the suspensory ligament anteriorly and the perforatus tendon posteriorly, and then through the METACARPO-PHALANGEAL SHEATH, gliding over the sesamoidean pulley and emerging through the ring of the perforatus tendon behind the fetlock. Then it descends between the two terminal slips of the perforatus tendon, glides over the supero-posterior smooth surface (pulley) of the os coronæ, and then widens out to form the *plantar aponeurosis*, which, after gliding over the inferior navicular surface anteriorly by means of a synovial membrane—the *navicular Sheath*—and being covered posteriorly by a fibrous layer-the *strengthening* (reinforcing) *sheath of the perforans*, is ultimately inserted into the pedal semilunar ridge and the triangular depression behind it, where it is covered by, and is firmly adherent to the plantar cushion posteriorly. *At the carpus and metacarpus* the tendon is in relation with the large metacarpal artery and internal metacarpal nerve and vein internally, and *at and below the fetlock* the digital vessels and nerves lie on either side of it.

The NAVICULAR OR SMALL SESAMOID SHEATH is the synovial membrane placed between the navicular bone and the inferior navicular (interosseous) ligament supero-anteriorly, and the plantar aponeurosis of the perforans tendon infero-posteriorly. It forms 2 *culs-de-sac*, one (superior) extending upwards as far as the inferior cul-de-sac, of the metacarpo-phalangeal sheath, and the other (inferior) being placed beneath the inferior navicular (interosseous) ligament.

The STRENGTHENING (reinforcing) SHEATH OF THE PERFORANS TENDON is a fibrous expansion which covers and inferiorly blends with the plantar aponeurosis of the perforans tendon, and is attached above on each side by a fibrous slip to the infero-lateral aspects of the os suffraginis.

6—*Ulnaris accessorius*:—O.—Summit and posterior border of the olecranon. I.—Principal tendon of the perforans, above the carpus. A.—Assists the perforans. N.—Ulnar.

7.—*Radialis accessorius*:—O.—Postero-internal part of the inferior third of the radial shaft.—I.—Perforans tendon, above the carpus. A.—Assists the perforans. N.—Median.

G.—Metacarpal Group.

1 and 2—*Interossei Metacarpei*:—O.—Fibrous tissue surrounding the head of the splint bones. I.—Band extending from the suspensory ligament to the extensor pedis tendon. A.—Very slighty assists the extensor pedis and gives the digit a slight lateral motion. N.—Metacarpal. R.—They lie between the splint bones and the suspensory ligament, one on each side.

3 and 4—*Lumbricales*:—O.—Side of the flexor perforans tendon, just above the ring of the perforatus. I.—Fibrous tissue beneath the *ergot* (horny growth) of the fetlock. A.—Very slightly assists the perforans. N.—Metacarpal. R.—One on either side of the perforans tendon, above the fetlock.

V. Pelvic (Hind) Limb.

A.—Gluteal Group.

1.—*Gluteus Externus* :—Consists of a muscular portion having 2 branches like those of the letter V and an aponeurotic portion posteriorly. O.—(anterior muscular branch)—Anterior iliac spine ; (posterior muscular branch)—2nd and 3rd sacral spines ; (aponeurotic portion)—gluteal fascia. I.—(muscular branches)—Femur, trochanter minor externus ; (aponeurotic)—Ischial tuberosity and sacro-sciatic ligament. A.—Abducts the thigh. N.—Anterior and posterior gluteal (Lesser sciatic).

2.—*Gluteus Maximus* :—O.—Shaft, dorsum (external surface), crest, and anterior and posterior spines of the ilium ; side of the sacrum, superior and lateral sacro-iliac ligaments, part of sacro-sciatic ligament, and the aponeurosis of the *common mass* of the loins (tendinous envelope of the longissimus dorsi). I.—Femur, summit of the trochanter major (by 1 tendon) ; ridge just below its convexity (by 2nd tendon which glides over the convexity by means of a synovial bursa) ; and back of the trochanteric ridge (by a 3rd *fleshy* slip). A.—Extends (carries backwards) and abducts the thigh ; when the femur (posterior limb) is fixed it raises the trunk and assists in *rearing*. N.—Anterior and posterior gluteal. R.—The great sciatic nerve and gluteal blood-vessels and nerves internally.

3.—*Gluteus internus* :—O.—Iliac shaft (just above the acetabulum), and superior ischiatic spine. I.—Inner side of the femoral trochanter major. A.—Abducts and rotates the thigh inwards. N.—Anterior gluteal. R.—The capsular ligament of the hip-joint internally to which it firmly adheres.

4.—*Rectus parvus* :—O.—Iliac shaft, near acetabulum and outside the origin of the outer head of the rectus femoris. I.—

Supero-anterior part of the femoral shaft. A.—Raises (or renders tense) the hip-joint capsule during flexion. N.—Anterior Crural or Anterior femoral. R.—The hip-joint capsule posteriorly, to which it firmly adheres.

5.—*Obturator externus* :—O.—Inferior surface of the pubis and ischium. I.—Femur, trochanteric fossa. A.—Adducts and rotates the thigh outwards. N.—Obturator. R.—The obturator foramen, ligament, blood-vessels and nerve externally.

6.—*Obturator internus* :—O.—Circumference of the obturator foramen. I.—Trochanteric fossa. A.—Rotates outwards and slightly abducts the thigh. N.—Obturator and a branch from great sciatic. R.—The pelvic fascia and peritoneum with important blood-vessels and nerves supero-internally (inside the pelvis); the sciatic nerves posteriorly (outside the pelvis). It with the pyriformis passes out of the pelvis through the lesser sciatic notch, joins with its tendon, and glides over a groove on the external border of the ischium by means of a synovial sheath.

7.—*Pyriformis*;—O.—Sacral transverse processes and inner surface of iliac shaft. I.—Trochanteric fossa. A.—Rotates the thigh outwards. N.—Branch from great sciatic. R.—The pelvic fascia and peritoneum internally (in its intrapelvic portion); the sciatic nerves posteriorly, and the obturator vessels and nerves inferiorly (in its extra-pelvic portion).

8 and 9.—*Gemellus anticus and posticus*;—O.—Outer border of the ischial shaft, the *anticus* above and before, and the *posticus* below and behind the common tendon of the obturator internus and pyriformis. I.—Trochanteric fossa. A.—Rotate the thigh outwards. N.—Branch from great sciatic. R.—The sciatic nerves posteriorly; the hip-joint capsule anteriorly.

B.—Internal Femoral Group.

1.—Sartorius :—O.—Iliac fascia, near the ilio-pectineal eminence (psoas parvus insertion). I.—Internal straight patellar ligament, in common with the gracilis. A.—Adducts and flexes the thigh. N.—Internal saphenic. R.—Its inner and posterior border forms a triangular space—the *femoral space*—with the iliacus and pectineus through which pass the femoral vessels and anterior crural nerve ; and from between it (in front) and gracilis (behind) pass out the saphenic vessels and nerves.

2.—*Gracilis* :—O.—Under surface of the ischio-pubic symphysis. I.—Internal straight patellar ligament and the supero-internal part of the tibial shaft. A.—Adducts the limb and tenses the tibial fascia. N.—Obturator. R.—Internal Saphenic vessels and nerves anteriorly ; posteriorly it blends with the aponeurosis of the biceps rotator tibialis and with it forms the tibial fascia.

3.—*Pectineus*:—O.—Pubic brim (anterior border) and under surface, and the pubio-femoral ligament, which penetrates the muscle. I.—Ridge on the inner side of the femoral shaft, extending from the trochanter minor internus to the nutrient foramen. A.—Adducts, flexes, and rotates the thigh inwards. N.— Obturator. R.—The femoral vessels anteriorly.

Triceps Adductor Femoris comprises from before backwards the Brevis, the Longus, and the Magnus.

4.—*Adductor brevis* :—O.—Pubis, under surface. I.—Femoral posterior surface, about the middle (with the adductor longus). A.—Adducts, flexes, and rotates the thigh outwards. N.—Obturator.

5.—*Adductor longus* :—O.—Ischium, under surface. I.—(The outer tendon)—The femoral posterior surface, outside the brevis ; (the inner tendon)—the tubercle on the inner side of the femoral internal condyle with the magnus and internal lateral (femoro-tibial) ligament. A.—Adducts, extends, and rotates the thigh outwards.

N.—Obturator. R.—The sciatic nerves externally, and the femoral vessels pass between its two insertions.

6.—*Adductor magnus*:—O.—Coccygeal fascia, and ischial tuberosity and under surface. I.—Tubercle on the inner side of the femoral internal condyle, with the longus. A.—Adducts and extends the thigh; when the limb is fixed it assists in *rearing*.

C.—External Femoral Group.

1.—*Triceps Abductor Femoris*:—O.—(Anterior portion)—Sacral spine, coccygeal fascia, sacro-sciatic ligament. and the ischial tuberosity; (Posterior portion)—Inferior ischiatic spine. I.—(Anterior portion by 2 tendons)—Femoral shaft, posterior surface (behind the trochanter minor internus); Patellar anterior surface, a synovial bursa intervening. (Posterior portion by 1 tendon)—Tibial crest through the tibial fascia. A.—Anterior portion extends the thigh and abducts the entire limb; posterior portion flexes the leg and tenses the tibial fascia. When the leg (limb) is fixed the entire muscle assists in *rearing* by extending the pelvis on the femur. N.—Posterior gluteal and great sciatic. R.—The sciatic nerves internally.

D.—Anterior Femoral Group.

1.—*Tensor fasciæ latæ*:—O.—Anterior iliac spine. I.—Fascia lata. A.—Flexes the thigh by raising the entire limb. It also tenses the fascia lata, and thus mechanically assists in keeping the stifle-joint extended and in maintaining the position of the limb when the animal is standing. N.—Anterior gluteal.

Triceps or Quadriceps Cruralis comprises the rectus femoris, vastus externus and—internus, and crureus.

2.—*Rectus femoris*:—O.—(2 heads)—Iliac shaft,—2 depressions—one above, and the other in front of the cotyloid rim.

I.—Patella, superior surface. A.—Flexes the femur and extends the leg. N.—Anterior crural or anterior femoral. R.—Its heads of origin are separated from the hip-joint capsule by a pad of fat.

3.—*Vastus Externus* :—O.—Femoral shaft, outer border with trochanter minor externus, and external half of its anterior surface. I.—Patella, superior surface and external border. A.—Extends the leg. N.—Anterior crural.

4.—*Vastus internus* :—O.—Femoral shaft, inner border with trochanter minor internus and inner half of its anterior surface. I.—Patella, superior surface and inner border. A.—Extends the leg. N.—Anterior crural.

5.—*Crureus* :—O.—Femoral shaft, anterior lower third. I.—Patella, superior surface ; and the stifle-joint capsule. A.—Renders the capsule tense and assists the vasti. N.—Anterior crural.

E. Posterior Femoral Group.

1.—*Biceps Rotator Tibialis* :—O.—Sacral spine and sacro-sciatic ligament (one head) ; Ischial tuberosity (second head). I.—Tibia, supero-internal part and anterior crest, blending with the tibial fascia. A.—Flexes and rotates the leg inwards, and tenses the tibial fascia. When the leg is fixed, it greatly assists in *rearing*. N.—Posterior gluteal and posterior crural. R.—The sciatic nerves anteriorly.

2.—*Ischio-femoralis* :—O.—Ischial under surface in front of its tuberosity. I.—Femoral shaft, posterior surface (behind the trochanter minor internus). A.—Extends and adducts the thigh. N.—Branch from great sciatic. R.—The sciatic nerves externally.

F.—Anterior Tibial Group.

1.—*Flexor metatarsi* :—Consists of a superficial or tendinous, and a deep or muscular portion.

(*a*). *Tendinous Portion*:—O.—Depression between the trochlea and external condyle of the femur, in common with the extensor pedis. I.—Anterior part of the superior extremity of the os metatarsi magnum (large tendon); external surface of the os cuboides (small tendon). A.—*Mechanically* flexes the hock by being rendered tense on flexion of the stifle-joint. N.—Anterior tibial. R.—It first passes through the superior tibial groove, between the anterior and external tibial tuberosities, where it is covered by the external synovial membrane of the stifle-joint, and below the groove it is attached to the extensor pedis and to the *fleshy portion*. In front of the hock it with the extensor pedis tendon passes under the superior band of the annular ligament, then forms a ring for the tendon of the *fleshy portion*, and ultimately bifurcates into 2 branches.

(*b*) *Fleshy portion*:—O.—Tibial shaft, upper outer third, and the tendinous portion. I.—After passing through the ring of the tendinous portion, it divides into a large and a small branch. (Large branch)—Os Metatarsi magnum, front of the superior end; (small branch) small cuneiform, inner side. A.—Flexes the hock. N.—Anterior tibial. R.—The anterior tibial vessels and nerve, and the tibial outer surface posteriorly.

2.—*Extensor pedis*:—O.—Depression between the femoral trochlea and external condyle, in common with the tendinous portion of the flexor metatarsi. I.—Capsular ligament of the fetlock-joint, the anterior surface of the two first phalanges, and the pyramidal process of the os pedis. A.—Extends the phalanges on each other successively, and flexes the hock. N.—Anterior tibial. R.—At the bend of the hock its tendon is covered and maintained in position by 3 transverse fibrous bands of the annular ligament. At the middle of the metatarsus it joins with the extensor pedis brevis and the peroneus tendon, and the united tendon at and below the fetlock adapts itself exactly like that of the fore limb.

3.—*Peroneus* :—O.—External femoro-tibial ligament, and the entire length of the fibula. I.—Extensor pedis tendon, about the middle of the metatarsus. A.—Assists the extensor pedis. N.—Musculo-cutaneous. R.—Its tendon passes through a groove on the tibial external malleolus and then over the external side of the tarsus where it passes through a synovial sheath formed in the external lateral ligament of the hock.

G.—Posterior Tibial Group.

1.—*Gastrocnemius externus:*—O.—(By 2 heads)–Ridge extending from the external condyle upwards in front of the supracondyloid fossa (outer head); and the supracondyloid crest (inner head). I.—Posterior part of the summit of the os calcis, a synovial bursa being interposed between the tendon and the bone. A.—Extends the hock-joint. N.—Internal popliteal or posterior tibial (continuation of the great sciatic). R.—The popliteal vessels and the great sciatic nerve anteriorly; the gastrocnemius internus first lies anteriorly, then to its inner side, and lastly posteriorly, and the two tendons unite to form the TENDO-ACHILLIS or *the tendon of the hock.*

2.—*Plantaris* :—O.—Fibular head, postero-external side. I.—Gastrocnemius externus tendon. A.—Feebly assists the preceding. N.—Branch from the internal popliteal.

3.—*Gastrocnemius Internus* (FLEXOR PEDIS PERFORATUS) :—O.—Femur, supracondyliod fossa. I.—postero-lateral aspects of the os calcis and os coronæ. A.—Flexes the pastern and fetlock joints, and extends the hock by its insertion into the os calcis. It also mechanically keeps the hock extended and prevents its flexion, when the animal is standing. N.—Internal popliteal. R.—Its tendon at first lies in front of the gastrocnemius externus tendon, winds round its inner side, and then on its posterior surface to reach the the summit of the os calcis. When it gains the summit, it forms a fibrous cap with a large intervening synovial bursa (which when

abnormally full forms '*capped hock*'), and sends off 2 slips, one on each side of the os calcis. Then it descends posteriorly in the metatarsal and digital regions in exactly the same manner as that of the anterior limb.

4.—*Flexor pedis perforans*:—O.—Tibia, supero-external tuberosity and infero-posterior triangular surface on its shaft; fibula; and fibulo-tibial interosseous ligament. I.—Os pedis, semilunar ridge and surface behind it. A.—Flexes the coffin, pastern, and fetlock joints, and assists in extending the hock. N.—Internal popliteal. R.—It arises by 2 heads succeeded by separate tendons which unite into one, a little above the hock. The united tendon crosses the posterior capsular ligament of the tibio-tarsal joint, and then passes through the TARSAL SHEATH on the inner side of the os calcis. Afterwards it descends behind the suspensory ligament, joins with the flexor pedis accessorius tendon, and then, half-way down the metatarsus, receives a re-inforcing band—the *check* or *subtarsal ligament*—from the posterior tarso-metatarsal ligament of the hock. At and below the fetlock it is disposed in exactly the same manner as that of the fore-limb.

TARSAL SHEATH is the canal through which passes the perforans tendon and is bounded externally by the inner grooved surface of the os calcis, anteriorly by the posterior tibio-tarsal and tarso-metatarsal ligaments, and internally by a fibrous arch which transforms the groove into the canal. This canal is lined by a large vaginal synovial membrane which extends upwards on the tibial inferior extremity and downwards to the middle third of the metatarsus, and forms, when abnormally full, what is called '*Thorough-pin*'.

5.—*Flexor pedis accessorius*:—O.—Supero-external tibial tuberosity, posterior side. I.—Flexor pedis perforans, at the upper third of the metatarsus. A.—Assists the perforans. N.—Inter-

nal popliteal. R.—The posterior tibial artery anteriorly. Its tendon first passes through a muscular groove in the perforans muscle, and then through a synovial sheath (theca) on the inner side of the tarsus.

6.—*Popliteus* :—O.—Lower and anterior fossa outside the external femoral condyle, and the stifle-joint capsular ligament. I.—Tibial shaft, supero-posterior triangular surface and upper third of inner border. A.—Flexes and rotates the tibia inwards, and tenses the stifle-joint capsule. N.—Internal popliteal. R.—The popliteal vessels and capsular (posterior) ligament of the stifle-joint anteriorly.

H.—Metatarsal Group.

1 to 4.—*Two Lumbrici* and *two interossei (metatarsi)* correspond to those of the fore-limb. N.—Metatarsal.

5.—*Extensor pedis brevis* :—O.—Astragalus, antero-inferior part. I.—United tendon of the extensor pedis and peroneus. A.—Assists the extensor pedis and peroneus in keeping the digit extended by rendering their united tendon tense, when the hock is flexed. N.—Anterior tibial. R.—The anterior tibial artery with its perforating pedal branch posteriorly.

Fasciæ.

As previously stated there are 2 kinds of fasciæ viz., superficial and deep.

The *Superficial fascia* is the fibro-areolar covering, lying immediately beneath the skin and investing almost the entire surface of the body. The *aponeurotic* or *deep fascia* is a dense fibrous membrane forming sheaths for the muscles and affording them broad surfaces for attachment. Some of the deep fasciæ require special mention.

Fasciæ of the Head.

The *Temporal fascia* covers the temporal fossa and is attached to the parietal ridge and to the zygoma.

Fasciæ of the Trunk.

They are the *cervical*, *dorso-lumbar*, *abdominal*, and *thoracic* fasciæ. The ABDOMINAL FASCIA includes (a) the *transverse fascia* or *fascia transversalis* (very thin in the horse) situated between the peritoneum and the transversalis abdominis, (b) the *iliac* fascia attached internally to the psoas parvus tendon and externally to the anterior iliac spine, and (c) the *pelvic fascia* lining the pelvic cavity, covering the psoas magnus and iliacus, and comprising the *obturator*, *recto-vesical*, *inguinal*, and *perineal fasciæ*. The THORACIC FASCIA closes the anterior opening of the thorax and maintains the relative positions of the various structures that pass through it into, and out of, the anterior aperture of the thoracic cavity.

Fasciæ of the Fore-limb.

(a) :—The *External scapular fascia* is attached to the scapular spine and cartilage of prolongment, and is continuous behind with the dorso-lumbar fascia and below with the (b) *Brachial fascia*, which invests the muscles of the arm. (c) The Antibrachial fascia is attached to the inner side and the distal end of the radius and to the olecranon. It embraces the muscles of the forearm, and inferiorly becomes continuous with the carpal annular ligaments and forms sheaths for the passage of the tendons.

Fasciæ of the Hind-limb.

(a).—The *Gluteal fascia* is attached to the anterior iliac and the sacral spines. (b) The *Femoral* or *Crural fascia* embraces the thigh muscles and its antero-external portion is named (c) the *fascia lata* which envelops the triceps cruralis and is attached below to the patella. (d) The *Tibial fascia* is attached to the tibial crest and inner side, and to the os calcis. Superiorly it covers the tibial group of muscles, and inferiorly is continuous with the tarsal annular ligaments and forms sheaths for the passage of the tendons.

☞ The following are the comparative tables in which are shown the differential characters in the skeletal bones of different domesticated animals, viz:—the solipeds (horse, ass, and mule), the ruminants (ox sheep and goat), the carnivora (dog and cat), and the omnivora (pig.)

Vertebral Column.

Number of Vertebræ.	Solipeds.	Ruminants.	Carnivora.	Pig.
Cervical.	7.	7.	7.	7.
Dorsal.	18 (or 19).	13.	13.	14.
Lumbar.	6 (5, ass and mule.)	6 (7, sheep).	7.	6 (or 7).
Sacral.	5.	5 (4, sheep and goat.)	3.	4.
Coccygeal.	15 to 18.	16 to 20 (16 to 24, sheep, and 11 to 12, goat.)	21 (16 to 21, dog).	21 to 23.

Cervical Vertebræ.

Designation.	Solipeds.	Ruminants.	Carnivora.	Pig.
Bodies.	Longest and thickest.	Shorter in the ox. (In the sheep and goat relatively longer than in the ox).	Proportionally large and thick.	Shortest and widest.
Inferior spine.	Well marked posteriorly.	Very well marked throughout.	*Idem* (of solipeds).	Absent.
Anterior extremity (head).	Convex, and well detached.	*Idem.*	Flat or concave and well detached.	Flat and not well detached.
Neural spine.	Mostly rudimentary.	Large.	High and prominent.	Rudimentary except the two last. *

* The anterior articular processes are pierced by a foramen and the neural arch is incomplete.

Atlas.

Transverse processes (Wings).	Slope downwards and backwards.	More horizontal and externally turned upwards.	Horizontal and turned backwards.	Horizontal. (*Vide* ‡ p. 165).

Vertebral (posterior) foramen.	Present.	Absent.	Present.	Present or absent.
Posterior facets (for the axis).	Wavy.	Nearly plane.	True glenoid cavities.	*Idem* (of ruminants).

Axis.

Odontoid process.	Conical, with smooth rounded under surface.	Flat or semicylindrical, with a prominent articular ridge on its under surface.	Convex on all sides. †	Invertedly conical and flat.
Neural spine.	Bifid posteriorly.	Single. *	Single and curved forwards, thus completely occluding the atlo-axoid space.	Bifid, and curved backwards. ‡

* The pedicles are perforated by a circular foramen.

† On either side of the odontoid process is a true condyle for the atlas and the anterior notches never converted into foramina.

‡ Transverse processes perforated by an enormous vertebral foramen.

Dorsal Vertebræ.

Bodies.	Short and thin.	Long and thick.	Short and thin.	Short and thick.
Facet for the rib tubercle.	Plane.	Convex. ¶	*Idem* (of solipeds)	*Idem* (of ruminants). ††
Posterior notches.	Sometimes converted into foramina.	Almost always, in the ox; never in the sheep and goat.	Never.	Sometimes.

¶ Transverse processes very voluminous.

†† Transverse processes pierced by a single or multiple foramen.

Lumbar Vertebræ.

Transverse processes.	Well developed, flattened anteriorly and posteriorly, and project horizontally outwards, and *the two last articulate with each other and the last with the sacrum.*	More developed than in the horse, are concave anteriorly and convex posteriorly, incline downwards, and *never articulate with each other or the sacrum.*	Flattend and *articulate* as in Solipeds but incline very much forwards and downwards. *	*Idem* (of Ruminants.) †

* The posterior notches are large and surmounted by an acute large backward prolongation, and the anterior articular tubercles are extremely prominent.

† The neural spines are bifid posteriorly.

Sacrum.

Sacral canal.	Somewhat triangular.	Oval.	Triangular.	Partly open due to non-union of the laminæ.
Sacral vertebræ.	5.	5 (ox), 4 (sheep and goat.)	3.	4.
Neural spines.	United at their base only, and free in the remainder of their extent.	Entirely consolidated in the ox, and late or never in the sheep and goat. *	Almost consolidated, presenting a serrated margin at their tops. †	Absent.

* The Sacrum in the ox is larger, more convex above, more concave below, with better marked promontory, larger inferior foramina, larger sacral cornua, and shorter and non-articular transverse processes than in the horse.

† The sacrum is as broad behind as in front and has bifid transverse processes.

Coccyx.

Articular processes.	Both anterior and posterior absent.	Anterior present in the first few. ‡	Both present in the first 5 or 6, but absent in the remaining vertebræ, which are V shaped and called *hypsiloid* bones.	Both present in the first few.

‡ The coccygeal Vertebræ are more strong and tuberous than in the horse.

Ribs.

Ribs	18 (rarely 19, horse), narrower and more arched (less arched in the ass and mule).	13, wider, less arched, and with longer neck.	13, narrower, thicker, and very much arched; and their *tubercle* facets are distinct from *head* facets.	14, wider and more arched than those of the sheep or goat, and their *tubercle* facets are confounded with *head* facets.
Sternal ribs.	8, and joined to their cartilages by synarthrodial joints.	8, and joined by real diarthrodial joints in the ox, and by synarthrodial in the sheep and goat.	9, and by synarthrosis. *	7, and by synarthrosis.
Asternal ribs.	10.	5.	4.	7.

* Their cartilages rarely ossify even at old age.

Sternum.

Sternebræ.	6 (or 7), *flattened laterally* and pyramidal, and united together by partial ossification.	7, *flattened above and below*, and united by complete ossification. †	8, flattened above and below and cylindrical laterally, and united by partial ossification.	7 (or 6), flattened and united as in large ruminants.

† In large ruminants the first piece joins with the second by a diarthrosis with lateral movements.

Cariniform Cartilage.	Keel-shaped and long.	Absent.	Present but very small.	Present and long but blunt.
Ensiform Cartilage.	Heart-shaped and attached to the body of the sternum.	Circular and well detached from the body of the sternum.	*Idem* (of solipeds).	*Idem* (of Ruminants).
		Occipital.		
Entire bone.	Made up of 4 pieces in very young animals, then of 2, and lastly united into one piece.	Single, wider but smaller than in the horse.	Very strong and triangular behind.	Not bent anteriorly, and is very short—with *perpendicular* wings.
Occipital crest.	Well marked.	Absent.	Rudimentary.	Absent.
Styloid processes.	Long and straight.	Shorter but broader and bent inwards.	Short.	Very long and bent backwards.
Condyloid foramina.	Single on each side.	Double or triple. Basilar process is shorter, thicker, and wider with wider basilar fissure than in the horse.	Single.	Single.
		Sphenoid.		
Pterygoid processes.	Long and flat laterally.	Larger and thinner.	Very short.	Large and flat antero-posteriorly.

Pterygoid foramen.	Present and double anteriorly.	Absent.	Present and single.	Absent.
Sella Turcica.	Shallow.	Deep. (In the sheep bounded posteriorly by the *posterior clenoid processes*).	Shallow, & bounded before and behind by the *anterior & posterior clenoid processes*.	Deep.
Foramen patheticum.	Present.	Absent.	Absent.	Absent.
Lacerum orbitale and rotundum foramina.	Separated by a plate of bone.	Not separated.	Separated.	Not separated.
Carotid and inferior maxillary notches.	Both present.	First absent, the second converted into foramen ovale.	First present in dog, absent in cat; the second converted into foramen ovale in both.	*Idem* (of solipeds).
		Ethmoid.		
Ethmoid cells.	Less developed.	More developed, and form a forward prologation, on each side, between the two turbinals, which is called the *olfactory antrum* or *cave* and looks like a third turbinal.	Well developed. *Ethmoidal fossæ are very deep.*	Well developed.

Parietal.

Parietal ridges.	Present.	Absent.	Greatly developed in the dog; absent in the cat.	Present.
Ossific Tentorium.	Prominent.	Indistinct. *The parietals partly support the horn cores.*	Prominent in the dog, and replaced in the cat by 2 transverse bony plates separating the cerebral, from the cerebellar, cavity.	Absent.

Frontal.

Supra-orbital foramen.	Single and near the orbit.	Double, far backwards from the orbit, and *continued by a groove.*	Absent.	Single and *continued by a groove.*
Foramen orbital internum.	Formed by the frontal and sphenoid.	Entirely on the frontal	Absent.	*Idem* (of ruminants).

Frontal arch.	Completely bony.	*Idem.*	Very short and completed by a ligament.	*Idem* (of carnivora).

* The frontal bones are very thick and large, and present two osseous conical processes—the *fruits* or *horn-cores*—to support the horns, and the large *frontal tuberosity* or *boss* in the centre.

Temporal.

Squamous and petrous portions.	Separate.	United into one.	United.	United.
Parieto-temporal conduit.	Excavated in both the parietal and squamosal bones.	In the temporal only and is larger.	In both bones.	Absent.
Glenoid cavity.	Elongated transversely.	*Idem.*	*Idem.*	Smallest transversely.
Anterior Mastoid process.	Moderate.	Large and prominent.	Rudimentary.	Absent.
Mastoid protuberance or Auditory bulla.	Little developed.	Very large.	Very large.	Very large.
Hyoid process.	Present.	Present.	Absent. *	Absent.

* The temporal fossæ are very deep.

Nasal.

Entire bone.	Long and slender.	Short and broad.	Small, narrow, and *wide in front.*	Long and strong.
Nasal peak.	Single and pointed.	Trifid and notched in the ox, and bifid or single in the sheep and goat.	Absent and replaced by a semi-circular concavity.	Single & pointed, and projects nearly to the level of the incisors.

Turbinals.

Turbinals.	Superior larger than the inferior.	*Vice versa.*	Both very long & extending to the anterior nares.	Longer and less fragile than in the horse.

Superior Maxilla.

Maxillary spine.	An elongated ridge continuous with the malar zygomatic spine.	A rough protuberance indirectly joining with the zygoma through a curved line.	Absent.	*Idem* (of solipeds).
Infraorbital foramen.	Opposite the 4th molar.	Opposite the 1st molar.	Opposite the 3rd or 4th.	Opposite the 3rd or 4th.
Alveolus for the tusk.	Present (in the male) but demi-alveolus.	Absent. *	Present and entire.	Present, entire, & large. †

* The superior maxilla is shorter but broader than in the horse.

† The bone has no alveolar tuberosity, very short interdental space, and centrally excavated external surface.

Premaxilla.

Foramen Incisivum.	Present.	Absent.	Small in the dog; absent in the cat.	Absent.
Alveoli for the incisors and tusk.	3 for the incisors and a demi-alveolus for the the tusk (in the male.)	All absent.	3 Incisive alveoli present, but the tusk alveolus is absent in this bone.	*Idem* (of carnivora). *

* Part of the cartilaginous septum nasi becomes ossified and forms the *prenasal* or *snout* bone (os rostri), and the anterior nares are small and round.

Malar.

Zygoma.	Unifid and joins with the squamosal zygoma.	Bifid; the superior branch unites with the frontal arch, and the inferior (posterior) with the temporal zygoma.	Bifid; between the two branches is wedged in the temporal zygoma, and the superior branch does not join with the frontal.	*Idem* (of Carnivora).

Lachrymal.

Lachrymal fossa.	Present in the orbital surface.	Replaced by a large protuberance in the ox; present in the facial surface in the sheep and goat.	Absent. *	Present in the facial surface. †

* In the cat the lachrymals are very small and confined to the orbit.
† Each of the lachrymals is pierced by 2 lachrymal canals which unite into one.

Palatine.

Palatine surface.	Small.	Extensive.	Very extensive.	More extensive than in the ox.
Palatine crest.	Rugged and formed by the posterior border of the bone.	Thin and formed by the posterior borders of the palatine and pterygoid bones and sphenopterygoid process. *	*Idem* (of solipeds).	Replaced by a tuberosity, which, with the pterygoid bone and sphenopterygoid process, forms a large trifid tubercle—the *Mamelon.*

* The posterior nares are very narrow and situated behind, and not between, the superior maxillæ.

Pterygoid

Entire bone.	Small, very narrow, and flat.	Very large.	Strong and quadrilateral.	Thick and forms the *Mamelon.*

Inferior Maxilla.

Maxillary Symphysis.	Ossifies in the adult.	Never ossifies.	Rarely ossifies.	Ossifies.
Condyle.	Large, elongated transversely, and doubly convex, *i.e.*, transversely as well as antero-posteriorly.	Small, elongated, and concave transversely and convex antero-posteriorly allowing considerable lateral motion to the joint.	Ovoid and elongated transversely.	Compressed transversely and elongated antero-posteriorly.

Coronoid Process.	Flat, thin, and bent backwards and inwards.	Long, thick, and bent backwards and outwards.	Long, broad, and thick.	Short, but broad and thick.
Sigmoid notch.	Less deep.	More deep.	More deep.	Less deep.
Interdental space.	Present.	Present.	Absent.	Very short.
Tusk-alveolus.	One on each branch (in the male).	Absent.	Present.	Present.
Incisor-alveoli	3 on each branch, thus 6 in all.	4 on each branch, thus 8 in all.	*Idem* (of solipeds).	*Idem* (of solipeds).
Mental foramen.	Single.	Single.	Double or triple.	Numerous and small.

Os Hyoides.

Spur process.	Long and sharp.	Very short, blunt, and thick.	Absent.	Absent.
Cornicula.	1 on each side, thus 2 in all.	2 on each side, thus 4 in all.	2 on each side, thus 4 in all. *	1 on each side, thus 2 in all and *consolidated with the body.*

* The middle and the two postero-lateral pieces of the body remain separated as in the fœtus, thus the hyoid bone is triple.

Pectoral Limb.

Shoulder (Scapula).

Shoulder.	Formed of 1 bone, the scapula.	Of 1 bone, the scapula.	Of 2 bones, the scapula and *clavicle* (well developed in the cat).	Of 1 bone, the scapula.
Coracoid Process.	Situated at a distance from the glenoid cavity.	Immediately applied against the glenoid cavity.	*Idem.*	*Idem.*
Spine.	Is very elevated in the middle forming the *tubercle*, and runs the whole length of the external surface, dividing it into a small anterior fossa and a doubly large posterior fossa.	Gradually rises from above to below to end in the *Acromion process*, and runs the whole length of the external surface, dividing it into a small anterior fossa and a trebly large posterior fossa.	Gradually rises from obove to below to end in the *acromion process*, and runs the whole length of the external surface, dividing it into 2 equal fossæ. *	Is very elevated in the middle forming the *Tubercle*, is *bent backwards*, and does neither end in the acromion process, nor run the whole length of the external surface which is divided by it into 2 nearly equal fossæ.

* The anterior border is very convex and the cartilage of prolongment is absent.

Humerus.

Humeral curve.	Is in proportion to the number of digits, thus very slight.	Marked.	Most marked like the letter S.	More marked.

Furrow of torsion or Humeral twist.	Very deep.	Deep.	Very shallow.	Shallow.
Deltoid or external tuberosity.	Very prominent and large.	Small.	Small.	Small.
Bicipital groove.	Double.	Single.	Single.	Single.
External Trochanter.	Smaller and not arching over the bicipital groove.	Larger and arching over. *	Large but not arching over. †	*Idem* (of ruminants).

* The head is larger than in the horse.

† In the cat there is a supracondyloid foramen internally.

Forearm (Radius and Ulna).

Radius and Ulna.	The development and movement of the ulna are *in direct proportion* to the number of digits, therefore it is smaller than the radius, extends to about its ⅔, and is firmly united with it by liga-	Both of about equal length, and united throughout their extent, though less firmly, by ligaments which become ossified. The Radius is smaller than in the horse, and	The ulna is longer than the radius. They merely unite at their extremities, and cross each other like the letter X, & the ulnar upper extremity with a	The ulna is longer than the radius and they are united throughout their extent by ligaments which rarely become ossified.

	ments, which become ossified early in life.	the ulna inferiorly articulates with the carpus.	concave facet articulates behind and internally with a convex facet on that of the radius, and the ulnar inferior extremity with a convex facet articulates with a concave facet on that of the radius. The ulna inferiorly articulates with the carpus.	The ulna inferiorly articulates with the carpus.'

Carpus.

Carpal bones.	7 (or 8), viz:—the scaphoid, semilunar, cuneiform, and trapezium forming the upper row, and the pisiform (generally absent), trapezoid, os magnum, and unciform forming the lower row.	6. Four in the upper row and two in the lower row,—the pisiform being absent, and the trapezoid and os magnum united into one.	In the dog 7, 3 in the upper row (as the scaphoid and semilunar are united into one), and 4 in the lower row. In the cat 8, 4 in each row.	8; 4 in each row.

Metacarpus..

Metacarpal bones.	3, 1 principal and 2 rudimentary (external and internal).	2, 1 principal and 1 rudimentary (external).	5; 1 rudimentary (internal) and 4 well developed, out of which 2 middle ones are longer than the two laterals.	4, all well developed, the middle ones larger than the two laterals.
Inferior extremity of the well-developed metacarpal.	Consists of 2 lateral condyles with a *median ridge*.	Of 2 lateral condyles with a *median fissure*.	Of one condyle only.	*Idem* (of Carnivora).

* The cannon bone has a shallow posterior and a deep anterior longitudinal groove ending inferiorly in an orifice, and a single postero-external facet superiorly for the splint bone.

Digit.

Number of digits, phalanges, and sesamoids including the navicular.	1 digit with 3 phalanges and 3 sesamoids.	4 digits; 2 perfect (medius and annularis) each having 3 phalanges and 3 sesamoids, and 2 rudimentary (index and auricularis).	5 digits; each except the internal has 3 phalanges and 2 sesamoids (one of them is placed anteriorly), the navicular being absent. †	4 digits; the thumb being absent; each has 3 phalanges and 3 sesamoids. The lateral ones (1st & 4th or auricularis and index) are shorter, & do not rest on the ground. ‡

* The phalanges resemble half of those of the horse and the sesamoid are smaller and narrower.

† The digits are from without inwards, the auricularis (minimus), annularis, medius, index, and pollex (thumb) which has only 2 phalanges, the mesian phalanx is wanting.

‡ The middle ones are the sole weight carriers.

Pelvic Limb.

Pelvis.

Direction of the coxæ.	Oblique from above to below and before to behind.	Nearly horizontal.	Nearly horizontal.	Nearly horizontal.
Transverse *inlet* diameter.	Greater than the vertical or Sacro-pubic.	Smaller than the vertical.	*Idem* (of ruminants).	*Idem* (of ruminants).
Transverse *outlet* diameter.	Greater than the vertical or sacro-ischiatic.	*Idem.*	Smaller than the vertical.	*Idem* (of Ruminants).
Inlet and outlet transverse diameters.	Greater at the inlet.	About equal.	Greater at the outlet.	*Idem* (of Ruminants).
Acetabulum.	Comparatively shallow.	Deep.	Very deep.	Deep.
Cotyloid notch.	Large, wide, single, and internally situated.	Narrow, deep, triple, and posteriorly situated.	Small, single, and internally situated.	*Idem* (of Ruminants), sometimes single.
Crest of the ileum.	Slightly concave with distinct prominent iliac spines.	Concave with prominent spines.	Concave with indistinct spines.	Very convex with prominent spines.
Superior ischiatic spine.	Rough ridge.	Very sharp and elevated process.	*Idem* (of solipeds).	*Idem* (of Ruminants).

Inferior ischiatic spine.	A ridge and separate from the ischial tuberosity.	A conical process and separate from the tuberosity.	Continuous with the tuberosity.	*Idem* (of Ruminants).
Ischial tuberosity.	Single.	Triple.	Single.	Single or triple.
Groove on the pubic under surface.	Wide channel.	Absent.	Absent.	Absent.
Pubic symphysis.	Ossifies in old age.	Never. *	Sometimes.	Never.

* In early life the ischial symphysis presents inferiorly an epiphysis called the *Inter ischial bone*, and, in adult life, a ridge and tubercle which are absent in solipeds, carnivora, and pig.

Femur.

Supracondyloid fossa.	Very Deep.	Shallow.	Absent and replaced by a tubercle.	Shallow.
Trochanter minor externus.	Present and very prominent.	Absent.	Absent.	Absent.
Trochanter minor internus.	A scabrous tuberosity quite separate from the trochanter major.	A small tubercle joining with the trochanter major by an oblique ridge.	*Idem* (of ruminants).	*Idem* (of ruminants).

Neck.	Very small.	Long.	Very long.	Long and very much contracted.
Trochanter Major.	Higher than the head and presents 2 distinct parts—the summit and convexity.	Nearly on a level with the head and presents a single mass.	Lower than the head and single.	On a level with the head and single.
Trochlea.	Wide.	Very narrow.	Narrow. *	Narrow.

* Above each condyle is a facet for sesamoid bones—one on each side—called the *Fabellæ* or *gastrocnemic sesamoids*, and posteriorly on the shaft there are two crests which correspond to the *linea aspera* of man.

N. B.—In all the domesticated animals except Solipeds the femur is more or less curved and prismatic; in the carnivora it is much curved like a bow.

Leg (Tibia, Fibula, and Patella).

Tibia.	Long and thick.	Shorter in the ox; longer in the sheep and goat.	Long and slender with a very prominent anterior border.	Long and slender.
Vertical notch on the anterior tuberosity and the external facet on the external tuberosity.	Both present.	Both absent.	Both present.	Both present.

External malleolus.	Consolidated with the tibia.	Separate as a distinct bone, the *malleolar bone*, which articulates with the tibia, calcis and astragalus, and represents the inferior extremity of the fibula.	Belongs to the fibula.	*Idem* (of Carnivora.
Patella.	Wide.	Comparatively very narrow and conical.	Narrow.	Narrow.
Fibula.	Rudimentary, articulating superiorly with the tibia and attached to it inferiorly by a ligamentous cord.	Absent or very rudimentary, articulating inferiorly with the tibia and superiorly attached to it by a ligamentous cord.	Very well developed and longer than the tibia, to which it is united at its two extremities by articulation, and by an interosseous ligament at its inferior two-thirds. It also articulates with the astragalus.	Developed and equal in length to the tibia, to which it is united at its two extremities only by articulation. It also articulates with the calcis.

* There is a small sesamoid bone on the external part of the tibial head.

Tarsus.

Tarsal bones.	6; Astragalus and calcis forming the upper row, and the cuboid and cuneiform magnum,—medium, and—parvum forming the lower row.	5; 2 in the upper row, and 3 in the lower row. (The cuboid and cuneiform magnum united into one, the *cubo-cuneiform*, bone.)	7; 2 in the upper, and 5 in the lower row. (The cuneiform medium divided into 2).	7. *Idem* of carnivora.
Astragalus.	Irregularly cuboid with 6 surfaces and a supero-anterior trochlea.	Elongated from above downwards and narrower with a deeper supero-antero-inferior trochlea.	Has a superior trochlea and an inferior head with a distinct neck for the cuneiform magnum.	Very much elongated and narrower with a supero-antero-inferior trochlea.
Calcis.	Long and flattened laterally with a tuberous summit.	Long and square with a posteriorly grooved summit.	Short and flattened laterally.	Very long and flattened laterally.

Metatarsus.

Metatarsal bones.	3, 1 principal and 2 rudimentary (external and internal).	2, 1 principal and 1 rudimentary. *	5, 4 well developed and 1 rudimentary (internal and often replaced by a ligamentous cord within which is a small bone, the first phalanx).	5, 1 very rudimentary (internal) and 4 well developed.

* The principal metatarsal in the ox is distinguished from that of the horse by being longer, quadrilateral in form and having a posterior groove on its superior extremity and a deep fissure separating the two condyles on its inferior extremity.

Digit (posterior).

Number of digits.	One, having 3 phalanges and 3 sesamoids.	Two, each having 3 phalanges and 3 sesamoids.	Four (sometimes 5), great toe often absent. Each has 3 phalanges and 2 sesamoids. †	Four, each having 3 phalanges and 3 sesamoids.

* *Ossa cordis* or *bones of the heart* are two in number, one on each side of the heart. In the camel there is a small bone in the diaphragm.

† *Os Penis* is a thin piece of bone, longitudinally grooved for the urethra, generally found in the carnivora, and always in the dog. It is less persistent in the cat. Anteriorly it is flat and pointed and to its both extremites are attached the cartilages.

Comparative Arthrology.

Common vertebral joints.

Designation.	Solipeds.	Ruminants.	Carnivora.	Pig
Ligamentum Nuchæ	Well developed, extends from the 3rd dorsal spine to the occipital cervical tuberosity, and attached to the summits of the neural spines. *	Very well developed, extends from the 3rd dorsal to the occiput, and attached to the sides of the neural spines. †	In the dog, it is a narrow fibrous band. In the cat, it is a mere fibrous raphe extending from the 1st dorsal to the occiput. ‡	*Idem* (of the cat).

* The transverse lumbo-sacral joints are present in the solipeds only.

† The Inferior common ligament is stronger and the intervertebral discs thicker than in the horse.

‡ The interspinous ligaments are replaced by the *interspinous muscles* throughout in the cat, and only in the cervical region in the dog.

Occipito-atloid joint.

Synovial Membranes.	Two.	Two.	One.	One.

Atlo-axoid joint.

Odontoid ligaments.	Two longitudinal, long and short ; each consisting of 2 lateral bands, which extend, respectively, to the foramen magnum and the atloid ring.	*Idem* (of solipeds).	Two ; one longitudinal having 2 lateral bands extending to the foramen magnum, and the other *transverse odontoid* which passes over the odontoid process maintaining it against the floor of the atloid ring.	*Idem* (of Carnivora).

Temporo-Maxillary joint.

Lateral and horizontal movements.	Free but moderate due to the shallow temporal glenoid cavity and the prominent anterior mastoid process.	*Idem.*	Restricted due to the maxillary condyle exactly fitting into the deep temporal glenoid cavity.	Horizontal glidings are very extensive due to the anterior mastoid process being very rudimentary.

Chondro-costal joints.

Joints.	Gomphotic synarthrodial with very obscure movements.	True ginglymoid diarthroses with movements facilitated by small synovial capsules.	*Idem* (of Solipeds).	*Idem* (of Ruminants).

Sternal joints.

Joints.	All synarthrodial bound together by the common superior sternal ligament and the intervening fibro-cartilages.	There is also a common *inferior* ligament, and the joint between the first two sternebræ is a diarthrosis.	*Idem* (of solipeds).	*Idem* (of Ruminants).

Shoulder joint.

Synovial capsule.	Entirely enveloped by the capsular ligament.	*Idem.*	Partly enveloped and forms in front a *cul-de-sac* in the bicipital groove for the flexor brachii.	*Idem* (of Carnivora).

Elbow joint.

Internal lateral ligament.	Longer than the external having 2 bands, both attached below to the radius.	Shorter, having 2 bands attached to the radius.	Almost equal, and has 3 bands, 2 of which are attached below to the radius and the third to the ulna. *	*Idem* (of Ruminants).

* There is an osteo-fibrous ring in which the radial head rotates.

Radio-ulnar joints.

Joints.	Two diarthrodial and two amphiarthrodial joints, united by 2 radiating and 2 interosseous ligaments of which the superior very rarely ossifies.	*Idem* of solipeds, but the superior interosseous ligament always ossifies at adult age.	Two-(superior and inferior) rotatory diarthroses with capsular ligaments allowing rotarory movements termed *pronation* and *supination.* †	*Idem*(of solipeds).

† The interosseous ligament is attached lengthwise to the radial and ulnar shafts.

Intermetacarpal joints.

Joints.	Two, formed by the cannon and 2 splint bones, held together by interosseous liagments & the carpal ligaments.	One, formed by the cannon and the single splint bone, the ligaments are similar to those in the horse.	Four, formed by 4 well developed metacarpals and 1 rudimentary, held together by interosseous ligaments and the great anterior and posterior carpal ligaments.	Three, formed by 4 well developed metacarpals. The ligaments are similar to those in the dog, but the mobility in the joints is not so great.

Metacarpo-phalangeal (fetlock) joint.

Joint.	Single, and has 3 proper ligaments (the anterior or capsular and the external and internal laterals) and 7 *accessory* or *sesamoidean* ligaments (a superior, 3 inferior, 2 lateral, and an intersesamoidean).	Double, and has 5 *proper* ligaments (a capsular, 2 external and 2 internal laterals), and 10 *accessory* (a superior, 4 inferior, 2 lateral, and 3 intersesamoidean).	Quincuple; each joint has a capsular, 2 laterals, and 4 sesamoidean ligaments (an inferior, 2 lateral, and an intersesamoidean).	Quadruple; and *Idem* of carnivora.
Suspensory or superior sesamoidean ligament.	Superiorly single but inferiorly divides into 2 to be attached to the two sesamoids ultimately reuniting as the broad ligament, which joins the extensor pedis tendon.	Superiorly single but inferiorly divides into 8 branches.	Replaced by the *interosseous palmar muscle* in each joint.	*Idem* of carnivora.
Inferior sesamoidean ligaments.	3; superficial, middle, and deep.	4; two central ones cross like the letter X, and 2 laterals (external and internal).	1 for each joint consisting of two cross-bands.	*Idem* of carnivora.

* Two of these branches form with the *perforatus* tendon two rings for the two branches of the *perforans* tendon; Four are attached to 4 sesamoids, of which the two external ones give off a band which joins the proper extensor tendon of each digit from *outside*; and the two remaining (central) after passing through the inferior metacarpal fissure separate from each other to join the proper extensor tendon of each digit from *inside*.

Proximal Interphalangeal joint.

Superior intredigital ligament.	Absent, as there is only one proximal phalanx.	1 present, which is crucial and placed between the two ossa suffraginis.	4 small present.	Three small present.
Internal lateral.	Single and attached below to the 2nd phalanx.	Double; one *short* attached below to the 2nd phalanx, and the other *long* attached below to the 3rd.	Single for each joint.	Single for each joint.
External lateral.	Attached below to the 2nd phalanx.	To both the 2nd and 3rd.	To the 2nd.	To the 2nd and the navicular.
Glenoid cartilage.	Attached to the 1st phalanx by 6 fibrous bands, 2 superior, 2 middle, and 2 inferior.	By 2 lateral bands to each 1st phalanx, thus 4 in all.	By simple cellular bands.	*Idem* of carnivora.

Distal Interphalangeal joint.

Proper ligaments.	4, two anterior and two posterior laterals.	For each joint there are the capsular and two posterior lateral ligaments. The two anterior laterals are replaced by the lateral ligaments of the pastern joints. There is an additional *inferior interdigital* ligament which joins the navicular and pedal bones of one side with those of the other.	For each joint there are two lateral ligaments and an *anterior elastic* one, which acts as the *retractor* of the claw and is stronger and more retractile in the cat than in the dog.	For each joint there are 2 lateral ligaments and a posterior one. The latter extends from the 1st phalanx to the inner side of the navicular, thus replacing the true internal navicular ligament.
Navicular ligaments.	The superior, inferior, and 2 laterals.	*Idem*, but the superior is wholly formed of elastic tissue and not fibro-elastic.	Wanting as the naviculars are wanting.	The superior, inferior, and external lateral in each joint. The internal lateral is wanting.

* In the sheep :—instead of a capsular there is an anterior elastic ligament which extends from the 2nd to the 3rd phalanx, and the inferior interdigital ligament joins the two naviculars only.

Pelvic Limb

Pelvic joint.

Ischio-pubic symphysis.	Even in the females the interosseous cartilage becomes well ossified at adult age.	In the females, the ossification is very slow.	*Idem* of Ruminants.	*Idem* of Ruminants.

Hip joint.

Pubio-femoral ligament.	Present, and thus preventing free abduction.	Absent, and thus allowing free abduction of the limb whereby they strike sideways, e.g. 'cow-kick.'	Absent.	Absent.

Stifle joint.

Straight Patellar ligaments.	3; external, middle, and internal.	3 in large ruminants, but 1 only in smaller.	1.	1.
Synovial membranes.	3; a superior and 2 laterals.	3 in large, but 1 in smaller ruminants.	1 for the whole joint. *	1.

* In the carnivora femoro-patellar capsular ligament is absent, and the femoro-tibial capsular (post. ment contains 2 small sesamoid bones for the two heads of the gastrocnemius externus muscle.

Tibio-Fibular joint.

Joint.	Single, superior, and arthrodial with a capsular ligament. Two interossei (supr and inf.) ligaments unite the fibular and tibial shafts.	Wanting as the fibular head and shaft are replaced by a ligamentous cord. The distal fibular extremity is a distinct bone called the *malleolar* bone.	Three; the sup. and inf. arthrodial with a capsular ligament and a middle amphiarthrodial with an interosseous ligament.	Three; the sup. and middle amphiarthrodial with an interosseous ligament, and an inferior arthrodial with a capsular ligament.

Hock joint.

Tibio-tarsal joint.	The tibial inferior extremity above, and the astragaloid trochlea below.	The tibial inf. extremity and the malleolar bone above, and the astragalus and calcis below.	The inf. extremities of the tibia and fibula above, and the astragalus below.	The inf. extremities of the tibia and fibula above, and the astragalus and calcis below.
Movements.	Restricted.	More than in solipeds, due to the greater mobility of the astragalus.	Much more.	*Idem* of Ruminants.

Panniculus Carnosus.

Cervical portion.	Single, entirely fleshy, and blended with the fibres of the *levator humeri*.	Single, distinct from the *levator humeri*, and aponeurotic above and fleshy below in the ox, and entirely aponeurotic in the sheep.	Double; one part arises from the cariniform cartilage, and the other from the external scapular region. The latter is more developed than in the pig.	*Idem* (of carni-
Abdominal portion.	Superiorly attached to the dorsal and lumbar spines by means of a thin fascia, and does not extend over the croup and haunch.	*Idem.*	Superiorly unites with its fellow of the opposite side along the dorso-lumbar spines, and extends over the croup and haunch. †	*Idem* (of Solipeds).

* In ruminants the facial portion of the panniculus carnosus forms the frontal expansion—the *Frontalis muscle*—which passes from the root of the horn core to the upper edge of the orbital fossa, where it blends with the levator palpebræ superioris externus.

† In the cat the panniculus carnosus is very well developed.

Anterior Maxillary Group.

Zygomaticus.	Arises from near the super-maxillary spine.	Extends by a long tendon of origin as far back as the malar zygomatic process.	Extends as far back as the squamosal zygoma, and is continuous with the *Attolens Anticus*. *	*Idem* (of Solipeds). *
Levator labii superioris alæque nasi.	Inferiorly divides into an anterior and a posterior branch, between which lies the *Dilatator Naris Lateralis* having the anterior branch under it and the posterior covering it.	Absent in small ruminants In large ruminants:—Between its branches lie the *Dilatator Naris Lateralis* and the *Nasalis longus*, both *covered by the anterior branch*, the posterior lying beneath them.	Inferiorly single, and inserted into the upper lip; the nasal insertion is wanting.	Absent.
Nasalis longus.	Single.	Treble; 1 principal and 2 accessory. All arise together and terminate in the upper lip.	Single, and joins with the *Dilatator Naris Lateralis* as a single muscle.	Double, su and inferior. †

* The Buccinator and Orbicularis Oris are very rudimentary.

† The SUPERIOR arises from the lachrymal fossa and is inserted in the middle of the snout. The INFERIOR arises from the front of the zygomatic ridge and terminates inferiorly into several fibrillæ, which are inserted below the nostril. The former elevates, and the latter depresses, the snout; both acting together draw the snout outwards.

Dilatator Naris Lat.,—Trans.,—Inf., & —Sup.	All present.	Only the Lateralis is present; others are absent. ‡	*Idem* (of ruminants).	All present except the Transversalis.

‡ DEPRESSOR LABII INFERIORIS has no tendon of insertion and is confounded with the Buccinator.

Posterior Maxillary Group.

Stylo-Maxillaris.	Present.	Absent.	Absent.	Absent.
Digastricus.	Two-bellied with an intermediate tendon.	Single-bellied. * †	Single-bellied.	Single-bellied.

* In the ox the *digastricus* is joined to its fellow by a *small square transverse muscle* beneath the base of the tongue, which elevates the hyoid bone and thus supplies the place of the mesian digastric tendon and the ring of the Hyoideus Magnus.

† In ruminants the *Internal Pterygoid muscles* arise nearer to the mesian line of the head due to the palatine ridges being closer together, and thus produce more lateral motion in the lower jaw than in solipeds. In them the *Masseter* and *Temporal* muscles are less strong than in the horse.

Hyoidean Group.

Hyoideus Magnus.	Has a short thick tendon of origin arising from the hyoid cornu, and a perforated tendon of insertion for the passage of the mesian digastric tendon.	Has a long thin tendon of origin arising from the hyoid cornu, and no ring in the tendon of insertion as the mesian digastric tendon is absent.	Has a short thin tendon of origin arising from the temporal mastoid portion, and no ring in the tendon of insertion. *	*Idem* (of ruminants).

* The *Hyoideus Transversus* and *Stylo-hyoideus* are absent.

Palpebral Group.

Lachrymalis.	Is thin and continuous above with the *Orbicularis Palpebrarum*, from which it can be separated.	Is more developed and thicker than in the horse, and intimately blends with the *Orbicularis Palpebrarum* from which it is difficult to separate it.	*Idem* (of solipeds).	Absent.

Orbital Group.

Retractor Oculi.	*Frequently* separated into 4 bundles.	Single, surrounding the optic nerve, and much more developed than in in other animals.	Always separated into 4 distinct bands resembling a second set of recti muscles, and inserted more posteriorly in the Sclerotic coat of the eye than in other animals.	*Idem* (of ruminants).

External Auricular Group.

The auricular muscles.	Join their fellows of the oppsite side in the mesian line.	Do not join in the mesian line, but are placed at the sides of the head below the horns.	Nothing remarkable.	Nothing remarkable save that the *Retrahens externus* has 2 tendons of insertion; one attached to the conchal and the other to the scutiform cartilage.

Inferior Cervical Group.

Sterno-maxillaris.	Inserted into the angle of the lower jaw.	Inserted into the occipital basilar process & hence termed the *Sterno-suboccipitalis.*	Inserted into the posterior mastoid process, and hence termed the *Sterno-mastoideus.*	*Idem* (of carnivora).
Sterno-thyro-hyoideus.	More or less digastric, i. e., having two bellies with a median tendon, arising from the cariniform cartilage, and inserted into the thyroid cartilage by one tendon and into the hyoid spur process by the other.	Not digastric, and is larger and thicker than in the horse.	Not digastric, and arises from the first costal cartilage.	Inserted into the thyroid cartilage by 2 tendons, and into the spur process by a third.
Subscapulo-hyoideus.	Extends from the subscapular fascia to the hyoid spur process.	Less developed, and extends from the 3rd or 4th cervical transverse process to the hyoid spur process, and hence termed the *Trachelo-hyoideus.* *	Wanting.	*Idem* (of ruminants).

* The Rectus Capitis Anticus Major is covered at its origin by the *Trachelo-atloideus*,—a flat muscle joining the atlas inferiorly with the 3rd to 6th cervical vertebræ and strengthening the neck when it is inclined to one side.

Scalenus (superior portion).	Inserted into the superior extremity of the 1st rib.	*Idem*	Extends to the 8th rib.	Extends to the 3rd rib.
Longus Colli.	Single.	Single.	Double.	Double.

Lateral (Superior) Cervical Group.

Levator humeri (superficial portion).	Is single superiorly, and arises from the posterior mastoid process and occipital mastoid ridge.	Is bifid superiorly, one (posterior) branch—the *clavicular portion of the trapezius*—arises from the mastoid process and ridge and the ligamentum nuchæ, and the other (anterior) branch—the *cleido-mastoideus*—from the basi-occipital bone by a tendon, also common to the sterno-sub-occipitalis.	Is bifid superiorly, and arises from the mastoid ridge and ligamentum nuchæ by 1 tendon, and from the posterior mastoid process by another tendon.	Is bifid superiorly, and arises from the side of the occipital (cervical) tuberosity by 1 tendon, and from the crest, that replaces the posterior mastoid process beneath the external auditory meatus, by another tendon.
Levator humeri (deep portion).	Arises from the atloid-wing by a tendon also common to the splenius and trachelo-mastoideus, and from the 2nd, 3rd, and 4th cervical transverse processes.	Arises from the atloid wing by a *separate* tendon from that of splenius and trachelo-mastoideus.	Arises from the atloid wing by a common tendon and *is inserted into the scapular spine.*	Arises from the atloid wing by a common tendon.

Rhomboideus longus.	Single at its origin, arising from the ligamentum nuchæ.	*Idem.*	Bifid at its origin, arising from the occipital mastoid ridge and from the ligamentum nuchæ.	Bifid, arising from the occipital (cervical) tuberosity and from the rudimentary ligamentum nuchæ.
Serratus magnus (cervical portion or Lev. Ang. Scapulæ).	Arises by 5 digitations from the last 5 cervical transverse processes.	By 6 digitations from the last 6 cervical transverse processes.	*Idem* (of ruminants).	*Idem* (of ruminants). Sometimes by 7 digitations from all cervical transverse processes.
Splenius.	Inserted into the occipital (mastoid) ridge, atloid wing, and 3rd to 5th cervical transverse processes by 5 separate digitations.	Into the occipital ridge and atloid wing by 2 digitations.	*Idem* (of Ruminants).	Into the occipital ridge, cervical tuberosity, and atloid wing by 3 digitations.

* In Ruminants the splenius is very small, and is almost absent in the camel.

Costal Group.

Latissimus Dorsi.	Simply covers the ribs, and is inserted into the internal tuberosity on the humeral shaft.	*Idem.*	*Idem* (of pig).	Attached to the surfaces of ribs, and inserted into the inner lip of the bicipital groove near the inner trochanter on the humeral superior

Superficialis Costarum.	Anterior portion is inserted into the 5th to 13th ribs; the posterior into the 9th to 18th.	Anterior into the 5th to 9th ribs, and posterior into the 10th to 13th.	Anterior into the 3rd to 10th ribs, and posterior into the 11th to 13th.	Anterior into the 5th to 10th ribs, and posterior into the 10th to 14th.
Levatores Costarum.	17. On each side.	12.	12.	13.
Intercostals.	17 external and 17 internal, on each side.	12.	12.	13.
Pectoral Group.				
Pectorals.	The *anticus* is well developed and distinct from the *Transversus*; and the *Parvus* distinct from the *Magnus*.	The *anticus* is small and blended with the *Transversus*; and the *Parvus* blended with the *Magnus*.	The *Transversus* and *Parvus* are very thin and small and blended with the *anticus* and *magnus* respectively.	*Idem* (of ruminants).
Abdominal Group.				
Tunica Abdominalis.	Is a moderately thick expansion of yellow elastic tissue.	Is very well developed, and wider and thicker than in the horse.	Is a very thin fold of cellulo-fibrous membrane.	*Idem* (of ruminants).
Obliquus abd. ext. aponeurossi.	Larger and wider than the *fleshy* portion, and posteriorly double to form the crural aponeurosis and crural arch or *Poupart's Ligament*.	Larger and wider than the fleshy portion, and posteriorly single to form the crural arch only.	Smaller and narrower than the fleshy portion, and single posteriorly.	*Idem* (of carnivora).

Obliquus Abdominis Internus.	The *fleshy* portion is smaller than the *aponeurotic*, and the Retractor Costæ is distinct from the principal muscle.	The *fleshy* is larger than the *aponeurotic*, and occupies the entire space between the ilium, last rib, and lumbar vertebræ, and the Retractor costæ is not distinct. *	*Idem* (of ruminants),	*Idem* (of ruminants).

* In ruminants the *lineæ transversæ* and the *fascia transversalis* are better marked, and the *diaphragm* is thicker and stronger, its crura longer and larger, and the muscular rim attached *more anteriorly*—(thus facilitating the aspiration of the paunch or 1st stomach in the middle of the last intercostal space)—than in the horse. *In the camel there is often a small bone in the diaphragm.*

† In carnivora both the *Psoæ* muscles do not extend into the thoracic cavity. The Psoas Magnus and Iliacus are little developed and become blended posteriorly into one muscle. The Quadratus Lumborum is better developed than in all other animals, and is confounded anteriorly with the Psoas Parvus which is relatively larger and longer than the Magnus.

External Scapular Group.

In the carnivora the *anterior portion of the Teres Externus* is a distinct muscle, the *Acromio-humeralis*, arising from the acromion process of the scapula and *its posterior portion* arises from the entire scapular spine.

The *Antea* and *Postea spinati* are inserted each by a single tendon only, into the outer humeral trochanter.

Anterior Brachial Group.

Flexor brachii.	Very thick, intersected by many tendinous fibres, and inserted into the radius (bicipital tuberosity) only.	Less thick and less tendinous than in the horse, and inserted into the radius only.	Less thick and less tendinous than in the horse, and inserted into both the radius and ulna (base of the olecranon).	*Idem* (of carnivora).
Coraco-humeralis.	Very long with 2 insertions; one above, and the other below and anteriorly to the humeral internal tuberosity.	*Idem.*	Short with a single insertion above the humeral internal tuberosity.	*Idem* (of carnivora), and is very tendinous.

Posterior Brachial Group.

Scapulo-ulnaris.	At its origin from the scapular posterior angle and border it is distinct from the Latissimus Dorsi.	*Idem.*	Continuous with the Latissimus Dorsi as if arising from its external surface.	*Idem* (of carnivora).

Anterior Antibrachial Group.

Extensor Metacarpi Magnus.	Inserted into the antero-internal tuberosity on the cannon head.	*Idem.*	Its tendon of insertion divides into 2 branches, which are attached to the superior extremities of the two inner (4th and 3rd) metacarpal bones i.e., those of the index and medius, and are called the *external radial muscles.*	Inserted into the superior extremity of the inner larger metacarpal bone i.e., that of the medius.
Extensor Metacarpi Obliquus.	Inserted into the inner splint head.	Inserted into the inner side of the cannon head.	Is called the *long abductor of the thumb*, and is inserted into its rudimentary metacarpus.	Inserted into the superior extremity of the inner smaller metacarpal bone i.e., that of the index.
Extensor Pedis.	Is a single muscle with 2 tendons of insertion; one small and external joins the extensor suffraginis tendon, and the other—principal	Is divided throughout its length into 2 muscles, the external called the **Extensor Communis Digitorum*, and the internal, the **Extensor*	Is a single muscle called the **Extensor Communis Digitorum* having a quadrifurcated tendon; each of	Is divided into 2 muscles—the **Extensor Communis Digitorum* and the **extensor Proprius Internus.*

	and internal—is inserted into the pedal pyramidal process.	*Proprius Internus.*	the 4 branches is inserted into the the mesian and distal phalanges of the 4 great digits (1st to 4th).	(*Vide* p. 208).
Extensor Suffraginis.	Is inserted into the superior extremity of the os suffraginis by a single tendon.	Is thicker than in the horse and is called the **Extensor Proprius Externus* which has 2 tendons of insertion. ¶ (*Vide* p. 208).	Is called the **Extensor proprius* (externus), and its tendon trifurcates, each branch being inserted into the anterior surface of the distal phalanx of each of the 3 outer digits (auri., annu., and med.).	Is called the **Extensor Proprius Externus* and its tendon bifurcates, each branch being inserted into the outer side of the distal phalanx of each of the 2 outer digits (auri. and annu).

* The Extensor Communis Digitorum extends and approximates (adducts) the digits, while the Proprii extend and separate (abduct) the digits.

† In ruminants both the *Extensor Communis Digitorum* and the *Extensor proprius internus* pass together through a groove on the inferior radial extremity, and just below the fetlock the *Communis tendon* bifurcates, each branch being inserted into the pyramidal process of each os pedis. The *Proprius internus tendon* is reinforced by 2 slips from the suspensory ligament of the fetlock at about the middle of the internal os suffraginis (first phalanx) at whose distal extremity it bifurcates,—one of the branches being inserted into the anterior surface of the inner mesian phalanx (os coronæ), and the other into the internal surface of the inner distal (3rd) phalanx or os pedis.

† In the pig the *Communis tendon* quadrifurcates, each branch being inserted into the pyramidal eminence of the distal phalanx of each of the 4 digits. The *Proprius internus tendon* bifurcates, each branch being inserted into the inner side of the 3rd or distal phalanx of each of the two inner digits (index and medius).

¶ In Ruminants the *proprius externus tendon* receives 2 slips from the suspensory ligament of the fetlock at about the middle of the outer os suffraginis at whose distal end it bifurcates, one of the branches being inserted into the anterior surface of the outer mesian phalanx and the other into the external surface of the outer distal (3rd) phalanx or os pedis.

Posterior Antibrachial Group.

Flexor Metacarpi Externus.	Its anterior tendon of insertion is attached to the outer splint head.	*Idem.*	To the head of the outermost metacarpus, i. e., of the auricularis.	*Idem* (of carnivora).
Flexor Metacarpi Internus.	Inserted into the inner splint head.	Into the large metacarpal head, inner side.	Into the metacarpus of the 4th digit (the index). * (*Vide* p. 209).	Into the metacarpus of the 2nd digit (the annularis).
Flexor Pedis Perforatus.	Is a single muscle with a single bifurcated tendon, which first passes *through* the carpal sheath and ultimately becomes attached to the supero-	Is a double muscle with two tendons, which unite at the middle of the metacarpus to form a single tendon which redivides into two, each of	Is a single muscle, whose tendon first passes *outside* the carpal sheath and then quadrifurcates, each branch	Is a double muscle with 2 tendons, each of which being attached to the 2nd or mesian phalanx of each of the two

	postero-lateral parts of the mesian phalanx (os coronæ) by means of its bifurcations.	which division adapting itself like the single bifurcated *perforatus* tendon in the horse. †	going to the 2nd or mesian phalanx of each of the four principal digits (the thumb excluded).	great digits (annularis and medius).
Flexor Pedis Perforans.	Is a single muscle with a single tendon inserted into the pedal semilunar ridge and the median imprints behind it.	Is a single muscle with a bifurcated tendon. ‡	Is a single muscle with a quinquefurcated tendon, each branch going to the 3rd or distal phalanx of each of the 5 digits. §	Is a single muscle with a quadrifurcated tendon, each branch going to the 3rd phalanx of each of the 4 digits (the thumb excluded).
Ulnaris and Radialis accessorii.	Present.	Absent.	(*Vide* p. 210) Present. †† (*Vide* p. 210) ¶ (*Vide* p. 210)	Absent.

* In Carnivora the Flexor Metacarpi Externus,—Medius or Obliquus, and—Internus are respectively called the *Posterior Ulnaris*, the *Anterior Ulnaris*, and the *Great Palmar*, the last arising from the inner side of the radial middle third and not from the humeral epicondyle as in the horse.

† Each of the redivision of the perforatus receives from the suspensory ligament a fibrous slip—the *Inferior check ligament*—which forms the annular sheath for each of the two portions of the perforans and which in Solipeds goes to the perforans tendon, thus in Ruminants *both the Superior and Inferior carpal or check ligaments* are attched to the perforatus tendon only, and none to the perforans.

‡ In Ruminants the perforans tendon bifurcates above the fetlock, and the two branches pass through the annular sheaths formed by the inferior check ligaments and the perforatus tendons, and become ultimately attached to the inferior surface of the 3rd phalanx (os pedis) where they blend with the plantar cushion, and with the inferior interdigital ligament in the ox tribe.

very thin tendon in the fibrous arch of the carpal sheath, and represents the *Palmaris Brevis* of Man.

†† (*Vide* p. 209). The Ulnaris and Radialis Accessorii arise, respectively, from the entire ulnar posterior surface and from the postero-superior part of the radial shaft, and are inserted into the perforans tendon.

¶ (*Vide* p. 209). In addition to these muscles there are 5 muscles proper to the forearm of Carnivora. (For their description *vide* p. 219).

Metacarpal Group.

Interossei Metacarpei.	Two.	Absent.	Four, and are called the *Palmares* or Interosseous palmar muscles (*vide* p. 220).	*Idem* (of Carnivora.)
Lumbricales.	Two.	Absent.	Three. (*vide* p. 220).	Single but very large, joining the flexor perforans tendon to the extensor proprius tendon of the small inner digit (index). †

* There are 8 additional muscles in the anterior foot of carnivora which, with the four interossei and three lumbricales, make up 15. (For their description *vide* pp. 220-221).

† There is an additional muscle in the anterior foot of the pig which, representing the *flexor brevis minimi digit* of the carnivora, arises on the outer side of the foot from the carpo-metacarpal ligament, and is inserted into the extensor proprius tendon of the small outer digit (auricularis) and its outer great sesamoid bone.

Gluteal Group.

Gluteus Externus.	Its tendinous portion is hidden by the Triceps Abductor Femoris but is quite distinct from it, and is inserted into the *trochanter minor externus* of the femur.	Intimately blends with the anterior portion of the Triceps Abductor Femoris, and is inserted into the *trochanter minor externus.*	*Largest of the glutei*; is distinct, and inserted below and behind the *trochanter major.*	*Idem* (of ruminants).
Gluteus Maximus.	*Largest of the glutei*, arises from the tendinous envelope of the longissimus dorsi as far forward as the last rib, and is inserted by 2 tendons and a fleshy slip (3rd insertion).	*Largest of the glutei*, but smaller and thinner than in the horse, and not so much prolonged in front on the longissimus dorsi. It has 3 insertions.	Smaller than the gluteus externus, does not extend in front beyond the iliac crest, and is inserted by a single tendon into the summit of the trochanter major and the trochanteric ridge.	*Idem* (of ruminants).
Gluteus Internus.	Single.	Divisible into 2 portions, and larger than in the horse.	Single.	Double.
Rectus Parvus and Pyriformis.	Present.	Absent. *	Present.	Absent

* In Ruminants and the Pig the *Obturator Internus* tendon passes out of the pelvis through the obturator foramen singly, and not through the lesser sciatic notch with the pyriformis as in the horse.

Internal Femoral Group.

Pectineus.	Bifid at its origin for the passage of the pubio-femoral ligament, and single at its insertion on the posterior middle third of the femoral shaft.	* Single at its origin, but bifid at its insertions. One branch is inserted as in the horse, the other (thin and pale) near the femoral internal condyle.	Single at its origin and single at its insertion on a rough line extending from the trochanter minor internus to the linea aspera.	*Idem* (of Ruminants).
Adductor Longus.	Bifid at its insertion. One branch is attached to the posterior middle third of the femur, and the other to the femoral internal condyle.	‡ Single at its insertion on the posterior middle third of the femur, and does not reach its internal condyle.	Single at its insertion which is attached to almost the entire length of the linea aspera.	‡ *Idem* (of Ruminants).
Adductor Magnus.	Inserted by a single tendon into the femoral internal condyle in common with the adductor longus and the internal femoro-tibial ligament.	Inserted by two tendons. One is attached as in the horse, the other to the inner side of the tibial superior extremity where it lies beneath the internal femoro-tibial ligament.	*Idem* (of Ruminants).	*Idem* (of Ruminants).

* In Ruminants and the Pig the *Sartorius* muscle is traversed by the femoral vessels at its origin.
† In Carnivora the *Sartorius* arises from the anterior iliac spine and venter ilii, and is inserted into the supero-internal part of the tibial shaft, and the *Gracilis muscle* is much thinner and smaller than in all other animals.
‡ In Ruminants and the Pig the *adductor brevis* muscle almost blends with the adductor longus.

External Femoral Group.

Triceps Abductor Femoris.	Its anterior and posterior portions are distinct from each other and from the tensor fasciæ latæ. The anterior portion is inserted into the femur (behind the trochanter minor internus) and the patella (external side), and the posterior into the tibial crest and fascia.	Its two portions are indistinctly isolated. The anterior portion has no femoral insertion, and is firmly united to the tensor fasciæ latæ and the gluteus externus at the trochancher major.	Its two portions are blended together, & inferiorly inserted, in common, into the tibial crest and the external patellar ligaments. The anterior portion does not arise from the sacral spine and coccygeal fascia, but from the ischial tuberosity only.	*Idem* (of Ruminants).

* The *Triceps abductor femoris* glides behind the trochanter major by means of a large synovial bursa which often becomes abnormally full and forms the **"Swelling or Gout"** of the larger ruminants. An another bursa, which facilitates the gliding of its patellar tendon over the femoral external condyle, also becomes similarly diseased. Its anterior portion firmly blends with, and is embraced between the two layers of, the tensor fasciæ latæ which is wider than in the horse and is largely developed. In debilitated ruminants the tensor fasciæ latæ often ruptures at the trochanter major, and instead of gliding on the inner surface of the triceps abductor femoris slips out in front of it, where it becomes so firmly fixed that to allow the limb to move it becomes sometimes necessary to cut across the fibres of the triceps abductor femoris.

Anterior Femoral Group.

* In carnivora the *tensor fasciæ latæ* has a small supernumerary muscle in front, which arises from the anterior iliac spine and is inserted into the external side of the patella.

† In the sheep and dog the *rectus femoris* has only one head of origin.

†† A small muscle, called the ILIO-FEMORALIS or ANTERIOR GRACILIS (not described by Strangeways), exists only in Solipeds and Carnivores. It corresponds in action to the scapulo-humeralis postieus of the pectoral limb, arising from the neck of the ilium outside the outer head of the rectus femoris and inserted into the hip-joint capsule and the supero-anterior part of the femur.

Posterior Femoral Group.

Biceps Rotator Tibialis.	Arises from the sacral spine and the ischial tuberosity.	Only from the ischial tuberosity.	*Idem* (of Ruminants).	From the ischial tuberosity, and slightly from the coccyx.

Anterior Tibial Group.

Flexor Metatarsi and Extensor Pedis.	The *tendinous portion* of the flexor metatarsi arises in common with the *extensor pedis* from a fossa between the trochlea and external condyle of the femur. Lower down they separate forming only 2 distinct muscles. The *Fleshy portion* of the flexor metatarsi arises separately.	The *tendinous portion* and the *extensor pedis* arise in common as in the horse forming a *complex muscle*, which is single at the origin but at the tibial superior third divides into 3 large fleshy muscles terminating inferiorly by 3 tendons. * (*Vide p.* 216) The *anterior* and the *external* of these respectively represent the tendinous portion and the extensor pedis. The *fleshy portion* is represented by a muscle called the *Tibialis anticus.*	The *Tendinous portion* is represented by a ligamentous cord which arises from a fibrous band binding down the tibialis anticus tendon at the bend of the hock. The *Fleshy portion* is represented by the †(*vide p.* 216) *Tibialis anticus*, & the Extensor pedis by the *Extensor communis digitorum* which arises from between the femoral trochlea & external condyle & is inserted by a quadrifurcated tendon into the 4 large digits as in the fore-limb.	*Idem* (of Ruminants.) (*Vide p.* 216)

Peroneus.	Is single.	Becomes the *Extensor proprius externus* and is inserted as in the fore-limb.	Is called the † *Peroneus brevis (lateralis)* and consists of a superior and an inferior part.	Becomes the *Extensor proprius externus* and is inserted as in the fore-limb.
Peroneus Longus.	Not a trace.	Present. ‡	Present. †	Present.

* (*Vide* p. 215) Out of these three muscles the *anterior* one, which represents and resembles in action the *tendinous portion of the flexor metatarsi*, is inserted into the two cuneiform (medium and parvum) bones and the head of the great metatarsus in Ruminants, and into the 1st and 3rd cuneiform bones in the Pig. It forms a ring in its tendon at the middle of the tibia for the passage of the tendon of the *Tibialis Anticus*, which represents the *fleshy portion of the flexor metatarsi* and is inserted into the two cuneiform (medium and parvum) bones and the head of the great metatarsus in Ruminants, and into the 3rd and 4th cuneiform bones in the Pig. The two remaining are the *external* and the *internal*, which are respctively termed the *extensor communis digitorum* and the *Extensor proprius internus* and are inserted just as in the fore-limb.

† For the description of the tibialis anticus & the peroneus brevis & longus of carnivores *vide pp.* 221-222.

‡ For the description of the peroneus longus of ruminants and the pig *vide pp.* 222-223.

Posterior Tibial Group.

Plantaris.	Present.	Present.	Absent.	Present.
Gastrocnemius Internus or Flexor Perforatus.	Inserted into the postero-lateral aspects of the os coronæ.	Is thicker in the fleshy portion than that of the horse, and its tendon divides, the divisions being inserted as in the fore-limb.	Is blended with the Gastrocnemius externus at its origin, and its tendon quadrifurcates, the four branches being inserted as in the fore-limb.	Its tendon bifurcates, and the bifurcations are inserted into the two great digits as in the fore-limb.
Flexor Pedis Perforans.	Its belly is partially bifid.	More clearly divisible into 2 parts, and its tendon is inserted as in the fore-limb.	Its tendon quadrifurcates, but if the hallux is well developed it quinquefurcates, each branch going to the distal phalanx of each digit. *	Its tendon quadrifurcates, the branches being inserted into all the digits as in the fore-limb.

* A distinct muscle—the *Tibialis Posticus*—is found lying between the flexor pedis perforans and—accessorius. It arises from the tibia (posterior surface) and fibula (supero-internal two thirds), and after passing in company with the flexor accessorius into its sheath and through the groove lined by a synovial membrane behind the tibial inferior extremity is finally inserted into the posterior tarso-metatarsal ligament.

Metatarsal Group.

Lumbricales.	Two.	Absent.	Three, resembling those of the fore-limb.	Absent.
Interossei Metatarsi.	Two.	Absent.	Four, just as in the fore-limb.	Four, resembling those of the fore-limb.
Extensor Pedis Brevis.	Single. It arises from the astragalus and is inserted into the conjoined tendon of the extensor pedis and peroneus.	Single, and inserted by a bifurcated tendon into the tendon of the extensor communis digitorum and that of the extensor proprius internus.	Treble. The three fasciculi arise from the inferior end of the os calcis or from the tendinous sheaths in the bend of the hock, and are inserted into the three outer branches of the extensor communis digitorum tendon which go to the three outer digits. ‡	Single, and inserted by a divided tendon into the extensor tendons of the two large digits (annularis and medius), and sometimes into the tendon of the extensor proprius externus.

‡ For additional muscles of the metatarsal region of carnivora *vide* p. 223.

Muscles proper to the forearm of Carnivora.

(*Vide* p. 210 Foot note¶) :—

1.—*Extensor pollicis et indicis* (Proper extensor of the Thumb and Index):—*O.*—Radial external side in common with the extensor metacarpi obliquus. *I.*—By a bifurcated tendon, into the last phalanx of the 5th digit (thumb), and into the second and third phalanges of the 4th digit (index). *A.*—Extends the 5th and 4th digits. *N.*—Branch from the Radial. *R.*—Its tendon crosses the knee (carpus) anteriorly, passes through the synovial sheath of the extensor communis digitorum which lies in front of it, and bifurcates to be inserted into the 5th and 4th digits.

2.—*Supinator longus* (Long Supinator) :—*O.*—Humeral epitrochlea in common with the extensor metacarpi magnus. *I.*—Radial inferior extremity, inner side. *A.*—Almost nil ; very slightly supinates the forearm. *N.*—Branch from the Radial.

3.—*Supinator brevis* (Short supinator):—*O.*—Small fossa outside the external humeral condyle and the external lateral ligament of the elbow joint. *I.*—Antero-internal part of the radial superior extremity. *A.*—Acts as a principal supinator i.e., rotates or pivots the radius on the ulna, turning the radial anterior surface outwards. *N.*—Branch from the Radial.

4.—*Pronator Teres* (Round pronator) :—*O.*—Small tubercle on the inner side of the internal humeral condyle. *I.*—Radial inner side, middle third. *A.*—Pronates the forearm i. e., rotates the radius inwards, turning its anterior surface forwards after it has been supinated and acting as an antagonist of the supinators. *N.*—Branch from the Median.

5.—*Pronator Quadratus* (Square Pronator) extends through out the entire length of the forearm from the elbow joint to the carpus :—*O.*—Ulnar posterior border. *I.*—Radial inner border. *A.*—Pronates the forearm assisting the pronator teres. *N.*—Branch from the Median.

Muscles of the Anterior Foot of Carnivora.

(*Vide* p. 210 Foot note*) :—

They are 15 in number viz., 4 interossei metacarpei or palmares, 3 lumbricales, 3 proper to the thumb (an abductor, an adductor, and a flexor), 1 proper to the index (adductor), 3 proper to the auricularis or small digit (an abductor, an adductor, and a flexor), and 1 proper to the palmar integument.

1, 2, 3, and 4.—*Interossei Metacarpei* (Palmares) :—*O.*—Back of the metacarpal bones of the 4 large digits (the thumb excepted), their intermetacarpal and the common posterior carpal ligaments. *I.*—Great sesamoids of the 4 large digits by bifid tendons, which afterwards wind round to the front of the 1st phalanx and join the extensor communis tendon. *A.*—Restrain undue extension of the digits, keep the extensor tendons into position, and flex the digits on the metacarpal bones,—thus they perform the part of the suspensory ligament of the Horse and Ox. *N.*—Ulnar.

5, 6, & 7.—*Lumbricales* :—*O.*—Perforans tendon, lying between its four outer (large) branches. *I.*—First (proximal) phalanges of the 3 outer digits, and sometimes the extensor proprius tendons. *A.*—Flex the proximal phalanges of the 3 outer digits. *N.*—Ulnar.

8.—*Abductor brevis pollicis* :—*O.*—Posterior carpal ligament. *I.*—Outer side of the rudimentary metacarpal bone and the first phalanx of the pollex (thumb). *A.*—Flexes and abducts the 5th digit or thumb. *N.*—Median.

9.—*Opponens pollicis* :—*O.*—Posterior carpal ligament. *I.*—Inner side of the rudimentary metacarpus of the thumb. *A.*—Adducts the thumb. *N.*—Median.

10.—*Flexor Brevis Pollicis* :—*O.*—Posterior carpal ligament. *I.*—Inner side of the 1st phalanx of the thumb. *A.*—Flexes the thumb. *N.*—Median.

11.—*Adductor indicis* :—*O.*—Posterior carpal ligament. *I.*—Supero-internal side of the 1st phalanx of the 4th digit or index. *A.*—Adducts the 4th digit. *N.*—Ulnar.

12.—*Abductor minimi digiti* :—*O.*—Trapezium (also called Pisiform). *I.*—Supero-external part of the 1st phalanx of the small (outermost) digit or auricularis. A.—Abducts the small (1st)digit. N.—Ulnar.

13.—*Opponens* (adductor) *minimi digiti* :—O.—Posterior carpal ligament. I.—Supero-internal part of the 1st phalanx of the small (1st) digit. *A.*—Adducts the small digit. *N.*—Ulnar.

14.—*Flexor minimi digiti*:—*O.*—Inferior uneiform ligament. *I.*—Abductor minimi digiti tendon. *A.*—Flexes the small digit. *N.*—Ulnar.

15.—*Palmaris Brevis* or *Cutaneous Palmar*:—*O.*—Palmar fascia covering the muscle of the anterior foot. *I.*—Palmar integument. *A.*—Wrinkles the skin of the posterior aspect of the foot. *N.*—Ulnar.

Some of the muscles of the Anterior tibial region of Carnivora.

(*Vide* p. 216 Foot note†) :—

Tibialis Anticus :—*O.*—The tibial crest and external tibial tuberosity. *I.*—Inner rudimentary metatarsus of the great toe or hallux, after receiving a thin muscular slip from the peroneus brevis or the middle of the fibula. (When the hallux is perfectly developed its tendon also sends a slip to its distal phalanx). *A.*—Flexes the tarsus and the inner metatarsus. *N.*—Anterior tibial. *R.*—At the bend of the hock its tendon is bound down by a fibrous band, which is attached to the tibial inferior extremity and from the inner side of which arises a strong ligamentous cord which passes under the tendon to reach the front of the hock, adheres to its capsular ligament, and ultimately terminates on the metatarsal head of the middle digit. This cord represents the tendinous por-

tion of the flexor metatarsi of the horse and binds the tibial inferior extremity to the third (middle) metatarsus, thus preventing undue extension of the tibio-tarsal joint.

Peroneus Brevis (lateralis) :—Consists of 2 parts—a superior and an inferior.

A.—*Superior Part* or Proper Extensor of the Outer Digit :—*O.*—Anterior border of the fibula, upper third. *I.*—Phalanges of the outer digit, uniting with the outer branch of the Extensor Communis Digitorum. *A.*—Extends the outer digit. *N.*—Musculo-cutaneous. *R.*—Its long thin tendon glides over the fibular inferior extremity (outer malleolus) underneath the peroneus longus.

B.—*Inferior Part* :—*O.*—Anterior border and external surface of the fibula, upper two-thirds. *I.*—Upper end of the external metatarsus. *A.*—Abducts the foot. *N.*—Musculo-cutaneous.

Peroneus Longus (lateralis) :—*O.*—Anterior part of the supero-external tibial tuberosity. *I.*—The outer metatarsus (by a short branch), and the inner metararsus i. e., that of the hallux or 5th digit (by the principal tendon). *A.*—Abducts the foot and flexes it when it is much extended. *N.*—Musculo-cutaneous. *R.*—The muscle covers the anterior tibial vessels. Its tendon glides over the fibular inferior extremity, and on reaching the tarsus divides into a short and a long branch. The short branch goes to the first (outer) metatarsus, and the long)principal tendon) after passing through a groove on the external surface of the cuboid runs transversely across and behind the inferior row of tarsal bones to reach he inner (5th) metatarsus.

Peroneus Longus (lateralis) of Ruminants and the Pig.

(*Vide* p. 216 Footnote‡) :—

Peroneus Longus (Lateralis) :—*O.*—Supero-external tibial tuberosity, anterior part. I.—The second cuneiform (parvum) bone

(by the principal tendon), and the outer side of the metatarsal head (by a small branch), in ruminants. (In the Pig it is inserted into the head of the inner or 5th metatarsus). *A.*—Abducts the foot. *N.*—Musculo-cutaneous. *R.*—Its long slender tendon passes at the tarsus through the fibrous groove of the proprius externus tendon lined by a synovial membrane, and then obliquely over it. It then runs backwards and outwards where it lies underneath the external tibio-tarsal ligament, and the calcaneo-metatarsal and the posterior tarso-metatarsal ligaments, which maintain it in position in a groove on the inferior surface of the cuboido-scaphoid bone, and is ultimately inserted into the second (*parvum*) cuniform and the metatarsal head by separate tendons.

Additional muscles of the Metatarsal region of Carnivora.

(*Vide* p. 218 Footnote‡):—

1.—A small rudimentary muscle—the *flexor pedis accessorius*—arises from the outside of the tarsus and is inserted by a thin aponeurosis into the posterior surface of the principal perforans tendon.

2.—A thin elongated muscle—the *abductor minimi digiti*—arises from the posterior tarso—metatarsal ligament, and is inserted into the proximal phalanx of the outer (small or 1st) digit.

3.—Two or three very rudimentary muscles, which arise from the inside of the tarsus and are attached below to the internal digit or hallux, represent the muscles proper to the hallux. They are sometimes absent.

4.—Several thin muscular fasciculi are found attached to the perforatus tendon. They represent the remnants of the flexor brevis digitorum of Man.

Table of Synonyms of Muscles.

☞ *The word "Idem" in any of the last three columns refers to the name in the first column.*

✱ The words in italics in the first column denote the nomenclature of muscles adopted by Professor Percivall for those under which they stand, the remaining muscles being termed just as by Strangeways.

Strangeways.	Chauveau.	M 'Fadyean.	Steel.
Abducens. (*Abducens or deprimens aurem.*)	Parotido-auricularis.	Parotido-auricularis.	Parotido-auricularis.
Accelerator urinæ.	Idem or Bulbo-cavernosus.	Idem.	Idem.
Adductor brevis.	Small adductor of thigh.	Adductor parvus.	(Small head of) Biceps adductor femoris.
Adductor longus.	Great adductor of thigh.	Adductor magnus.	(Large head of) Biceps adductor femoris.
Adductor magnus.	Semimembranosus.	Semimembranosus.	Semimembranosus. (Ischio-tibialis).
Anconeus.	Idem or small extensor of forearm.	Idem.	Idem.
Antea-spinatus.	Superspinatus.	Supraspinatus.	Idem.

Aryteno-pharyngeus.	Idem.	Idem.	Idem.
Arytenoideus.	Idem.	Idem.	Idem.
Attolens Anticus.	Zygomatico-auricularis.	Zygomatico-auricularis.	Attrehens anticus.
Attolens maximus.	Temporo-auricularis externus.	Parieto-auricularis externus.	Attrehens maximus.
Attolens posticus.	Temporo-auricularis internus.	Parieto-auricularis internus.	Attrehens posticus.
Biceps rotator tibialis. (*Adductor tibialis.*)	Semitendinosus.	Semitendinosus.	Idem or Semitendinosus.
Buccinator. (*Idem and Caninus.*)	Alveolo-labialis.	Idem.	Idem and Caninus.
Caput magnum.	Large extensor of forearm.	Idem.	Idem
Caput medium.	Short extensor of forearm.	Idem.	Idem.
Caput parvum.	Middle extensor of forearm.	Idem.	Idem.
Complexus major.	Great complexus.	Complexus.	Idem.
Complexus minor.	(Part of) Great posterior rectus of head.	(Part of) Rectus capitis posticus major.	Idem.
Compressor coccygis.	Ischio-coccygeus.	Idem.	Idem.
Constrictores vulvæ (anterior and posterior).	Idem.	Idem.	Sphincter vulvæ or vaginæ.
Coraco-humeralis.	Idem, Coraco-brachialis or Omo-brachialis.	Idem.	Idem.
Cremaster.	Idem.	Idem.	Idem.
Crico-arytenoideus lateralis	Idem.	Idem.	Idem.

Strangeways.	Chauveau.	M 'Fadyean.	Steel.
Crico-arytenoideus posticus.	Idem.	Idem.	Idem.
Crico-pharyngeus. (*Constrictor pharyngis posterior.*)	Idem or Inferior constrictor of pharynx.	Idem.	Idem.
Crico-thyroideus.	Idem.	Idem.	Idem.
Crureus.	(Part of) Vastus internus.	Idem.	(Part of) Vastus internus.
Curvator coccygis.	Sacro-coccygeus lateralis.	Idem.	Idem.
Depressor coccygis.	Sacro-coccygeus inferior.	Idem.	Idem.
Depressor labii inferioris.	Maxillo-labialis.	Idem.	Retractor labii inferioris.
Depressor labii superioris.	Middle (intermediate) anterior.	Idem.	Idem.
Detrusor urinæ.	(Un-named)	(Un-named).	Idem.
Diaphragm.	Idem.	Idem.	Idem.
Digastricus.	(Part of) Idem.	Idem.	Idem.
Dilatator naris inferioris. (*Part of Nasalis brevis labii superioris.*)	(Part of) Small Super-Maxillo-nasalis.	Idem.	Dilator naris inferioris.
Dilatator naris lateralis.	Great supermaxillo-	Idem.	Retractor labii superioris.

Dilatator naris superioris. (*Part of Nasalis brevis labii superioris.*)	(Part of) Small supermaxillo-nasalis.	Idem.	Dilator naris superioris.
Dilatator naris transversalis. (*Dilator naris anterior.*)	Transversalis Nasi.	Idem.	Dilator naris anterior & Cornealis transversus.
Erector clitoridis.	(Un-named).	Idem.	Idem.
Erector coccygis.	Sacro-coccygeus superior.	Idem.	Idem or Levator coccygis.
Erector penis.	Ischio-cavernosus.	Idem.	Idem.
Extensor metacarpi magnus.	Anterior extensor of metacarpus.	Idem.	Idem.
Extensor metacarpi obliquus.	Oblique extensor of metacarpus.	Idem.	Idem.
Extensor pedis (fore—and—hind limbs).	Anterior extensor of phalanges.	Idem.	Idem.
Extensor pedis brevis.	Pedal muscle.	Extensor brevis.	Extensor pedis accessorius.
Extensor suffraginis.	Lateral extensor of phalanges (fore-limb).	Idem.	Idem.
Flexor brachii.	Long Flexor of forearm. (Brachial biceps).	Biceps.	Idem or Coraco-radialis,
Flexor metacarpi externus. (*Epitrochlo-carpeus.*)	External flexor of metacarpus or Posterior ulnaris.	Idem.	Idem.

Strangeways.	Chauveau.	M. Fadyean.	Steel.
Flexor metacarpi internus. (*Epicondylo-metacarpeus.*)	Internal flexor of metacarpus or Palmaris magnus.	Idem.	Idem.
Flexor metacarpi medius. (*Epicondylo-carpeus.*)	Oblique flexor of metacarpus or Anterior ulnaris.	Idem.	Idem.
Flexor metatarsi.	Flexor of metatarsus.	Idem.	Idem.
Flexor pedis accessorius. (*Flexor accessorius.*)	Oblique flexor of phalanges.	Flexor accessorius.	Idem.
Flexor pedis perforans (fore-limb).	Deep flexor of phalanges.	Idem (Humeral, radial and ulnar heads).	Idem.
Flexor pedis perforans (hind-limb).	Deep flexor of phalanges.	Idem.	Idem.
Flexor pedis perforatus (fore-limb).	Superficial flexor of phalanges.	Idem.	Idem.
Flexor pedis perforatus (hind-limb).	Superficial flexor of phalangex.	Idem.	Gastrocnemius-internus.
Gastrocnemius externus.	Gastrocnemii or Gemelli of tibia.	Gastrocnemius.	Idem.
Gastrocnemius internus.	Superficial flexor of phalanges (hind limb).	Flexor pedis perforatus (hind limb).	Idem.
Gemelli (gemini).	Idem of pelvis.	Idem.	Gemini vel ischio-trochanterius.

Genio-hyo-glossus.	Genio-glossus.	Genio-glossus.	Idem.
Genio-hyoideus.	Idem.	Idem.	Idem.
Gluteus externus.	Superficial gluteus.	Superficial gluteus.	Idem.
Gluteus internus.	Deep gluteus.	Deep gluteus.	Idem.
Gluteus maximus.	Middle gluteus.	Middle gluteus.	Idem or gluteus medius.
Gracilis.	Short adductor of leg.	Idem.	Idem.
Humeralis obliquus. (*Humeralis externus.*)	Short flexor of forearm or Brachialis anticus.	Brachialis anticus.	Humeralis externus.
Hyo-epiglottideus.	Idem.	Idem.	Idem.
Hyo-glossus brevis.	Great hyo-glossus or Basio-glossus.	Great hyo-glossus.	Idem.
Hyo-glossus longus.	Stylo-glossus.	Stylo-glossus.	Idem.
Hyo-glossus parvus.	(Part of) Basio-glossus.	Small hyo-glossus.	Idem.
Hyo-pharyngeus.	Idem or First middle constrictor of pharynx.	Idem.	Hyo-thyro-pharyngeus.
Hyo-thyroideus.	Idem.	Thyro-hyoid.	Thyro-hyoideus.
Hyoideus magnus.	Stylo-hyoideus.	Stylo-hyoideus.	Idem.
Hyoideus parvus.	Kerato-hyoideus.	Cerato-hyoid.	Idem.
Hyoideus transversus.	Transversalis hyoidei.	Idem.	Idem.
Iliacus.	Iliac psoas.	Idem.	Idem.
Inferior oblique of eye.	Small (lesser) oblique of eye.	Idem.	Idem.
Intercostales.	External & Internal intercostals.	External and Internal intercostals.	Intercostales externus and internus.
Interossei metacarpi. (*Lumbrici anteriores.*)	Metacarpal interossei.	Interossei (anterior).	Idem.
Interossei metatarsi. (*Lumbrici anteriores.*)	Metatarsal interossei.	Interossei (posterior).	Idem.

Strangeways.	Chauveau.	M 'Fadyean.	Steel.
Intertransversales lumborum.	Intertransverse of loins.	Intertransversales of loins.	Intertransversales et lumborum.
Intertransversalis colli.	Intertransverse of neck.	Intertransversalis of neck.	Idem.
Ischio-femoralis.	Square crural.	Quadratus femoris.	Idem.
Kerato-pharyngeus. (*Hyo-pharyngeus.*)	Stylo-pharyngeus.	Stylo-pharyngeus.	Hyo-pharyngeus (in part).
Lachrymalis.	Idem or lachrymo-labialis.	(Un-named).	(Un-named).
Lateralis sterni	Transverse muscle of ribs.	Idem.	Idem.
Latissimus dorsi.	Great dorsal.	Idem.	Idem.
Laxator tympani.	Idem.	Idem.	Idem.
Levator ani.	(Un-named).	(Un-named).	Idem.
Levator humeri.	Mastoido humeralis.	Mastoido humeralis.	Idem.
Levator labii inferioris. (*Levator menti.*)	Middle (intermediate) posterior, and Mento-labialis.	Levator menti.	Idem.
Levator labii superioris alæque nasi.	Supernaso-labialis.	Idem.	Idem.
Levator palati. (*Stylo-pharyngeus.*)	Peristaphyleus internus.	Idem.	Stylo-pharyngeus (in part).
Levator palpebræ superioris externus.	Fronto-superciliaris.	Corrugator supercilii.	Idem.

Levator palpebræ superioris internus.	Levator palpebræ or Orbito-palpebralis.	Levator palpebræ superioris.	Idem.
Levatores costarum.	Supercostals.	Idem.	Idem.
Lingualis.	Idem.	(Un-named).	Idem.
Longissimus dorsi.	Ilio-spinalis.	Idem.	Idem.
Longus colli.	Long muscle of neck.	Idem.	Idem.
Lumbricales. (*Lumbrici posteriores.*)	Lumbrici.	Idem.	Lumbrici.
Masseter.	Idem.	Idem.	Masseter externus.
Mastoido-auricularis.	Idem or Tympano-auricularis.	Idem.	(Not described).
Mylo-hyoideus.	Idem.	Idem.	Idem.
Nasalis longus. (*Nasalis longus labii superioris.*)	Supermaxillo-labialis.	Levator labii superioris proprius.	Nasalis longus labii superioris.
Obliquus abdominis externus.	Great or External oblique of abdomen.	Idem.	Idem.
Obliquus abdominis internus.	Small or Internal oblique of abdomen.	Idem and Retractor costæ.	Idem and Retractor costæ.
Obliquus capitis anticus. (*Obliquus capitis superior.*)	Small oblique of head.	Obliquus capitis superior.	Obliquus capitis superior.
Obliquus capitis posticus. (*Obliquus capitis inferior.*)	Great oblique of head.	Obliquus capitis inferior.	Obliquus capitis inferior.
Obturator externus.	External obturator.	Idem.	Idem.
Obturator internus.	Internal obturator.	Idem.	Idem.

Strangeways.	Chauveau.	M 'Fadyean.	Steel.
Orbicularis oris.	Labialis.	Idem.	Idem.
Orbicularis palpebrarum.	Orbicular of eyelids or Musculus ciliaris.	Idem.	Idem.
Palato-glossus.	Second stylo-pharyngeus.	Idem.	Stylo-pharyngeus (in part).
Palato-staphylinus. (*Circumflexus Palati.*)	Palato-staphyleus.	Azygos-uvulæ.	(Un-named.)
Panniculus carnosus.	Fleshy panniculus and cuticularis of neck.	Idem.	Idem
Pectineus.	Idem.	Idem.	Idem.
Pectoralis anticus. (*Part of Pectoralis transversus.*)	Sterno-humeralis or (Part of) Superficial pectoral.	Anterior superficial pectoral.	Idem.
Pectoralis magnus.	Sterno-trochineus or (Part of) Deep pectoral.	Posterior deep pectoral.	Idem (in part).
Pectoralis parvus.	Sterno-prescapularis or (Part of) Deep pectoral.	Anterior deep pectoral.	(Part of) Pectoralis Magnus.
Pectoralis transversus.	Sterno-aponeuroticus or (Part of) Superficial pectoral.	Posterior superficial pectoral.	Idem.
Peroneus.	Lateral extensor of phalanges (hind limb).	Idem.	Idem.
Pharyngo-glossus.	Idem.	Small stylo-pharyngeus and middle hyo-glossus.	Palato-pharyngeus (in part.)

Pharyngo-staphylinus. (*Palato-pharyngeus in part.*)	Idem or Palato-pharyngeus.	Palato-pharyngeus.	(Part of) Palato-pharyngeus.
Plantaris.	Soleus or Solearis.	Soleus.	Idem.
Popliteus.	Idem.	Idem.	Idem.
Postea-spinatus.	Subspinatus.	Infraspinatus.	Idem.
Postea-spinatus minor.	Short abductor of arm (Teres minor).	Teres minor.	Scapulo-humeralis externus.
Psoas magnus.	Great psoas.	Idem.	Idem.
Psoas parvus.	Small psoas.	Idem.	Idem.
Pterygo pharyngeus. (*Part of Palato-pharyngeus.*)	Idem or Superior constrictor of pharynx.	Idem.	(Part of) Palato-pharyngeus.
Pterygoideus externus.	Idem.	Idem.	Pterygoideus.
Pterygoideus internus.	Idem.	Idem.	Masseter internus.
Pyriformis.	(Part of) Obturator internus	Idem.	Idem.
Quadratus lumborum. (*Sacro-lumbalis.*)	Square muscle of loins.	Idem.	Idem.
Quadriceps (triceps) cruralis.	Crural triceps.	Quadriceps extensor cruris.	Triceps extensor cruralis.
Radialis accessorius.	(Part of) Deep flexor of phalanges (fore-limb).	(Radial head of) Flexor pedis perforans (fore-limb).	Idem.
Recti oculi (sup. inf. ext. and int.).	Idem.	Idem.	Recti oculi (levator, depressor, abductor and adductor).
Rectus abdominis.	Great rectus of abdomen.	Idem.	Idem.

Strangeways.	Chauveau.	M 'Fadyean.	Steel.
Rectus capitis anticus major.	Great anterior straight of head.	Idem.	Idem.
Rectus capitis anticus minor.	Small anterior straight of head.	Idem.	Idem.
Rectus capitis lateralis. (*Obliquus capitis anticus.*)	Small lateral straight of head.	Idem.	Obliquus capitis anticus.
Rectus capitis posticus major.	(Part of) Posterior great straight of head.	Idem (in part).	Idem.
Rectus capitis posticus minor.	Small posterior straight of head.	Idem.	Idem.
Rectus femoris. (*Rectus.*)	Anterior straight of thigh (Middle portion of triceps).	Idem.	Idem.
Rectus parvus. (*Crureus.*)	Anterior gracilis.	Idem.	Ilio-femoralis.
Retractor ani.	Idem or Ischio-anal.	Idem.	Idem.
Retractor oculi.	Idem or Posterior rectus of eye.	Idem.	Idem.
Retractor penis.	Retractile cords of the penis.	Idem.	Idem.
Retrehens externus.	Cervico-auricularis superioris (superficial).	Cervico-auricularis externus.	Idem.

Rétrahens internus.	Cervico-auricularis inferioris (deep).	Cervico-auricularis internus.	Idem.
Retrahens medius.	Cervico-auricularis medius.	Cervico-auricularis medius.	Idem.
Rhomboideus brevis, Rhomboideus longus,	Rhomboideus.	Dorsal Rhomboideus, Cervical Rhomboideus.	Rhomboideus.
Sartorius.	Long adductor of leg.	Idem.	Idem.
Scalenus.	Idem.	Idem.	Idem.
Scapulo humeralis posticus (grele). (*Scapulo-humeralis gracilis.*)	Small scapulo-humeral.	Scapulo-humeralis gracilis.	Idem.
Scapulo-ulnaris. (*Part of Caput Magnum.*)	Long extensor of fore-arm.	Idem.	Idem.
Scuto-auricularis externus. (*Anterior conchæ.*)	Idem.	Idem.	Idem.
Scuto-auricularis internus. (*Posterior conchæ.*)	Idem.	Idem.	Idem.
Semispinalis dorsi et lumborum. (*Semispinalis of back and loins.*)	Transverse spinous muscles of back and loins.	Semispinalis of back and loins.	Idem.
Serratus Magnus. (*Cervical portion.*)	Angular muscle of scapula.	Levator anguli scapulæ.	Idem.

Strangeways.	Chauvean.	M 'Fadyean.	Steel.
Serratus Magnus. (*Costal portion*).	Great serratus.	Serratus magnus.	Idem.
Sphincter ani.	Idem.	Idem.	Idem.
Sphincter vesicæ.	Idem.	Idem.	Idem.
Spinalis colli.	Transverse spinous muscle of neck.	Semispinalis colli.	Idem.
Spinalis dorsi.	(Part of) Ilio-spinalis.	(Part of) Longissimus dorsi.	Idem.
Splenius.	Idem.	Idem.	Idem.
Stapedius.	Idem.	Idem.	Idem.
Sterno-maxillaris.	Idem.	Idem.	Idem.
Sterno-thyro-hyoideus.	Sterno-thyroideus and Sterno-hyoideus.	Idem.	Idem.
Stylo-hyoideus.	Occipito-styloideus.	Occipito-styloid.	Idem.
Stylo-maxillaris.	(Part of) Digastricus.	Idem.	Idem.
Subscapularis.	Idem.	Idem.	Idem.
Subscapulo-hyoideus.	Idem or Omo-hyoideus.	Idem.	Idem.
Superficialis costarum (anterior and posterior).	Small anterior and posterior serrated muscles.	Serratus anticus and posticus.	Serratus parvus anterior and posterior.
Superior oblique of eye.	Great oblique of eye.	Idem or Trochlearis.	Idem
Temporalis.	Temporal or Crotophitic muscle.	Idem.	Idem.
Tensor fasciæ latæ. (*Tensor vaginæ femoris.*)	Muscle of the Fascia Lata.	Tensor vaginæ femoris.	Tensor vaginæ femoris.

Tensor palati.	Peristaphyleus externus.	Idem.	Idem.
Tensor tympani.	Idem.	Idem.	Idem.
Teres externus (minor).	Long abductor of arm. (Scapular portion of deltoid).	Deltoid.	Idem.
Teres internus (major).	Adductor of arm or Teres major.	Teres major.	Idem.
Thyro-arytenoideus.	Idem.	Idem.	Idem. (posticus and anticus).
Thyro-pharyngeus.	Idem, or Second middle constrictor of pharynx.	Idem.	Idem or Second middle constrictor of pharynx.
Trachelo-mastoideus.	Small complexus.	Idem.	Idem.
Transversalis abdominis.	Transverse muscle of abdomen.	Idem.	Idem.
Transversalis costarum.	Common intercostal.	Idem.	Idem.
Trapezius cervicalis.	Trapezius.	Cervical Trapezius.	Cervical Trapezius.
Trapezius dorsalis.		Dorsal Trapezius.	Trapezius.
Triangularis sterni. (*Sterno-costales interni.*)	Triangular muscle of sternum.	Idem.	Idem.
Triceps abductor femoris. (*Biceps abductor femoris.*)	Long vastus.	Biceps femoris.	Idem.
Triceps adductor femoris.	Great and small adductors of thigh and Semimembranosus.	Adductors magnus and parvus and Semibranosus.	Biceps adductor femoris and Semimembranosus.

Strangeways.	Chauveau.	M 'Fadyean.	Steel.
Triceps cruralis.	Crural triceps.	Quadriceps extensor cruris.	Triceps extensor cruralis.
Triceps extensor brachii.	Idem.	Triceps extensor cubiti.	Idem.
Ulnaris accessorius.	(Part of) Deep flexor of phalanges (fore-limb).	(Ulnar head of) Flexor pedis perforans (fore-limb).	
Vastus externus.	Idem.	Idem.	Idem.
Vastus internus.	Idem.	Idem.	Idem.
Wilson's. (*Triangularis penis.*).	Idem or Spincter urethræ.	Idem or constrictor urethræ.	Idem.
Zygomaticus.	Zygomatico-labialis.	Idem.	Idem.

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„	2	„	20	„ ave *read* have.
„	3	„	16	„ wnich *read* which.
„	12	„	23	„ limi *read* limited.
„	18	„	last	„ infrior espine *read* inferior spine.
„	29	„	30	„ af *read* of.
„	34	„	last	„ rontal *read* frontal.
„	40	„	27	„ abital *read* orbital.
„	46	„	last	„ inerior *read* inferior.
„	53	„	11	„ interior *read* inferior.
„	53	„	26	„ semlilunar *read* semilunar.
„	56	„	11	„ te *read* to.
„	60	„	16	Omit 'or.'
„	62	„	19	*for* mallelous *read* malleolus.
„	81	„	18	„ steatiform *read* stratiform.
„	82	„	4	„ find *read* bind.
„	83	„	8	„ sinovial *read* synovial.
„	87	„	6	„ Obiiquus *read* obliquus.
„	96	„	14	„ below the *read* below to the.
„	110	„	1	„ clafication *read* classification.
„	119	„	8	„ laryx *read* larynx.
„	119	„	19	„ peforated *read* perforated.
„	122	„	25	„ æsophagus *read* œsophagus.
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„	150	„	16	„ porterior *read* posterior.
„	151	„	19	„ in *read* it.
„	181	„	14	„ ileum *read* ilium.
„	214	„	6	„ (not described by strangeways) *read* (Rectu Parvus of Strangeways).
„	223	„	11	„ cuniefrom *read* cuneiform.

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